Series 1960, No. 15 Issued March 1964

SOIL SURVEY

Yoakum County Texas

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
TEXAS AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Yoakum County, Tex., will serve several groups of readers. It will help farmers and ranchers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; and add to our knowledge of soil science.

Locating soils

Use the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map has been found, it will be seen that boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they occur on the map. The symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where the symbol belongs.

Finding information

This report contains sections that will interest different groups of readers, as well as some sections that may be of interest to all.

Farmers and ranchers and those who work with them can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Use and Management of the Soils." In this way, they first identify their soils and then learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units, Capability Units, and Range Sites" at the back of the report will simplify use of the map and report. This guide lists each soil mapped in the county, and the page where it is described. It also lists for each soil the capability unit and range site in which the soil has been placed and the pages on which these are described.

Engineers will want to refer to the section "Engineering Interpretations of the Soils." Tables in that section show characteristics of the soils that affect engineering.

Scientists and others who are interested will find information about how the soils were formed and how they were classified in the section "Genesis, Classification, and Morphology of the Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Yoakum County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," which gives additional information about the county.

* * * * *

Fieldwork for this survey was completed in 1960. Unless otherwise indicated, all statements in the report refer to conditions in the county at that time. The soil survey of Yoakum County was made as part of the technical assistance furnished by the Soil Conservation Service to the Yoakum Soil Conservation District.

U.S. GOVERNMENT PRINTING OFFICE:1964

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402

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Issued March 1964

SOIL SURVEY OF YOAKUM COUNTY, TEXAS

BY WILLIAM H. DITTEMORE, JR., AND HAROLD W. HYDE, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

YOAKUM COUNTY is in the extreme southern part of the High Plains (Llano Estacado) in the Great Plains. Plains, the county seat, is on U.S. Highway No. 380, about 15 miles east of the Texas-New Mexico State line.

The county is square and covers 830 square miles, or 531,200 acres. The location of Yoakum County in Texas is shown in figure 1.

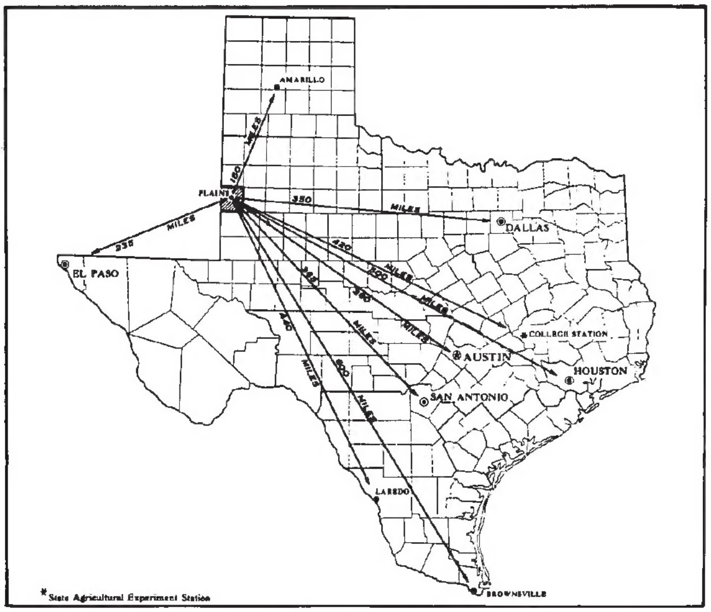

***Figure 1.*—Location of Yoakum County in Texas.**

The growth and development of the county have been based almost entirely on agriculture. In the past 30 years, huge cattle ranches have been divided, and the land has been used more intensively by farmers. The development of irrigation wells has changed land use from ranching to farming.

Because of low moisture and high winds in the spring months when most cropland is bare, wind erosion is a hazard. Since much of the acreage used for crops is subject to wind erosion, permanent pasture would be a better use.

Like other areas in the Southern Great Plains, Yoakum County has periods of drought. There are good years, or years of ample moisture, when crops may be above average. During some dry years, crops are produced only on the best soils under good management.

Because the climate is semiarid, farmers cannot rely on continuous high yields under dryland farming. The soils respond well to irrigation. If they are adequately irrigated and fertilized, they produce high yields.

What crops are best adapted to each soil? What treatment does each soil need? What is the erosion problem? How much will each soil produce? What practices and treatments will control erosion on each soil? How many kinds and types of soil are there, and what are the characteristics of each? This report answers these and other questions for the farmers, ranchers, and other landowners of Yoakum County.

How Soils Are Named, Mapped, and Classified

Soil scientists made this survey to learn what kinds of soils are in Yoakum County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Amarillo and Brownfield, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many soil series contain soils that are alike except for texture of their surface layer. According to this difference

in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Amarillo fine sandy loam and Amarillo loamy fine sand are two soil types in the Amarillo series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Amarillo fine sandy loam, 1 to 3 percent slopes, is one of two phases of Amarillo fine sandy loam, a soil type that ranges from nearly level to gently sloping.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used photos for their base map because these show woodlands, buildings, field borders, trees, and similar details that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientist has a problem of delineating areas where different kinds of soils are so intricately mixed and so small in size that it is not practical to show them separately on the map. Therefore, he shows this mixture of soils as one mapping unit and calls it a soil complex. Ordinarily, a soil complex is named for the major soil series in it, for example, Kimbrough-Stegall complex.

If two or more soils that normally do not occur in regular geographic association are so intricately mixed that separate mapping is impractical, the soils are mapped together as an undifferentiated mapping unit. The unit is named for the soils in it. An example in Yoakum County is Springer and Brownfield soils, moderately shallow.

After the soil scientist had named and described the soil series and mapping units, and had shown the location of the mapping units on the soil map, there was additional work to be done. The mass of detailed information he had recorded then needed to be presented in different ways for different groups of users, among them farmers, managers of rangelands, and engineers.

To do this efficiently, he had to consult with persons in other fields of work and jointly prepare with them groupings that would be of practical value to different users. Such groupings are the capability classes, subclasses, and units, designed primarily for those interested in producing the short-lived crops and tame pasture; range sites, for those using large tracts of native grass; and the classifications used by engineers who build highways or structures to conserve soil and water.

General Soil Map

After studying the soils in a locality and the way they are arranged, it is possible to make a general map that shows the main patterns of soils. Such a map is the colored general soil map in the back of this report. These patterns are called soil associations. Each kind of association, as a rule, contains a few major soils and several minor soils in a pattern that is characteristic, although not strictly uniform.

The soils within any one association are likely to differ greatly among themselves in some properties; for example, slope, depth, stoniness, or natural drainage. Thus, the general map does not show the kind of soil at any particular place, but main patterns of soils. Each pattern, or soil association, may contain several different kinds of soil.

Each soil association is named for the major soil series in it, but, as already noted, soils of other series may also be present. The major soil series of one association may also be present in another, but in a different pattern.

The general map that shows patterns of soils is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the possible location of good-sized areas suitable for a certain kind of farming or other land use.

Brownfield-Tivoli association: Deep, undulating sandy soils

This association occupies nearly level to gently sloping plains and strongly sloping, stabilized dunes (fig. 2). It occurs in a band, 4 to 6 miles wide, along the northern edge of the county. It occupies about 53,000 acres, or about 10 percent of the county.

This association consists of Brownfield fine sand and Tivoli fine sand. The Tivoli soils are on the dunes. They consist of loose sand that extends to a depth of many feet. The Brownfield soils are on gently sloping to nearly level plains and are intermingled with the Tivoli soils. They are noncalcareous soils that have a sandy surface layer and a sandy clay loam subsoil. The sandy surface layer of both soils is highly susceptible to wind erosion.

All of this association is in range, and most of it makes up parts of large cattle ranches. The native vegetation on most of the soils is characterized by thick stands of shin oak and scattered plants of sand bluestem, sand dropseed, and three-awn. Good range management is needed to maintain a cover of protective grasses. Where the cover is reduced or destroyed, the soils are highly susceptible to wind erosion.

This association is not suited to cultivation.

Amarillo association: Deep sandy and loamy soils

This association is on a broad, nearly level to gently sloping plain, mostly in the east-central part of the county. It consists mainly of Amarillo fine sandy loam and Amarillo loamy fine sand. These soils have a reddish sandy clay loam subsoil that is noncalcareous and moderately permeable. The association makes up about 10 percent of the county.

About 90 percent of this association is cultivated, mainly to cotton and grain sorghum. The rest is in native range.

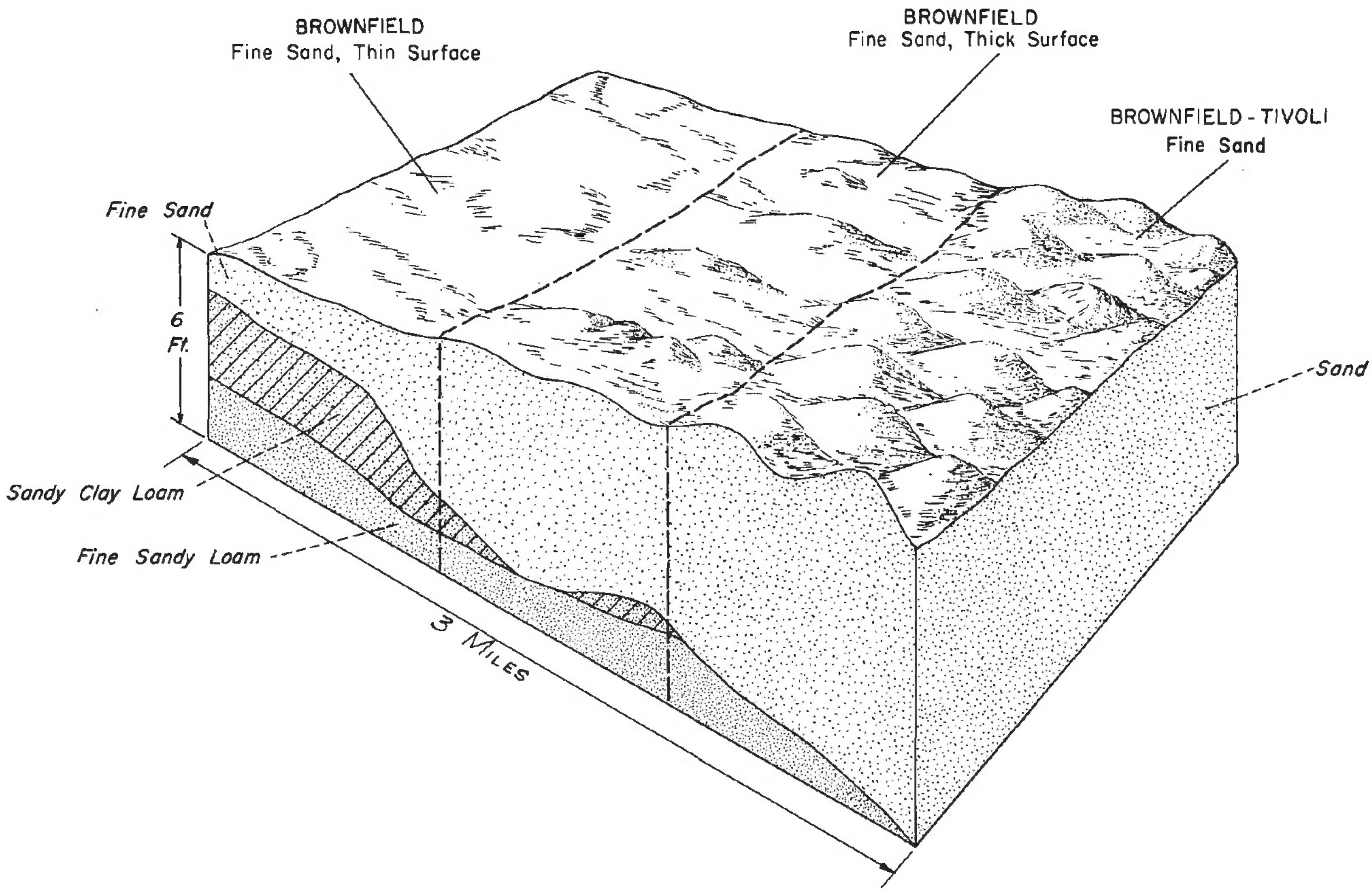

Figure 2.—**Brownfield-Tivoli association.**

A good stand of sand dropseed, hooded windmillgrass, and three-awn is characteristic of the native vegetation on most of Amarillo loamy fine sand. Stands of yucca and sand sagebrush grow in spots. The characteristic vegetation on Amarillo fine sandy loam is a good stand of black and blue grama and stands of mesquite and catclaw in spots.

The soils of this association are susceptible to wind erosion, and good management practices are needed for its control.

Brownfield-Amarillo association: Deep sandy soils

The soils of this association are gently sloping or nearly level to undulating (fig. 3). They are mainly fine sands and loamy fine sands. The association makes up about 60 percent of the county.

Brownfield and Amarillo are the main soils. The Brownfield soils are the most extensive. They are less brown and have a sandier surface layer than the Amarillo soils. The Amarillo soils have a loamy fine sand surface layer. Both the Amarillo and Brownfield soils have a reddish, noncalcareous sandy clay loam subsoil that is moderately permeable.

There are a few small areas of Lea loam, shallow, and Arvana soils along the New Mexico line in the southwestern corner of the county.

About 60 percent of this association is cultivated; the rest is in range. The main cash crops are grain sorghum and cotton. About 40,000 acres, or 25 percent of the cultivated area, is irrigated by sprinklers that receive water from wells yielding 200 to 800 gallons per minute. The rangeland is in poor to fair condition.

The native vegetation on most of the soils is characterized by thick stands of shin oak and scattered plants of sand dropseed and three-awn.

The sandy surface layer of these soils is highly susceptible to wind erosion. Good management practices are needed to maintain a cover of protective grasses.

Amarillo-Arvana association: Deep and moderately deep loamy soils

The soils in this association occupy a nearly level to gently sloping plain that is mostly in the southwestern part of the county. The association makes up about 5 percent of the county.

This association consists mainly of Amarillo fine sandy loam and Arvana fine sandy loam. These soils have a fine sandy loam surface layer and a noncalcareous sandy clay loam subsoil. The Amarillo soils have soft caliche parent material. The shallower Arvana soils have hard rock at a depth of 10 to 36 inches.

There is a small area of Lea loam, shallow, in the extreme southwestern corner of the county.

The Amarillo soils make up about 60 percent of the association. They are very productive. The Arvana are

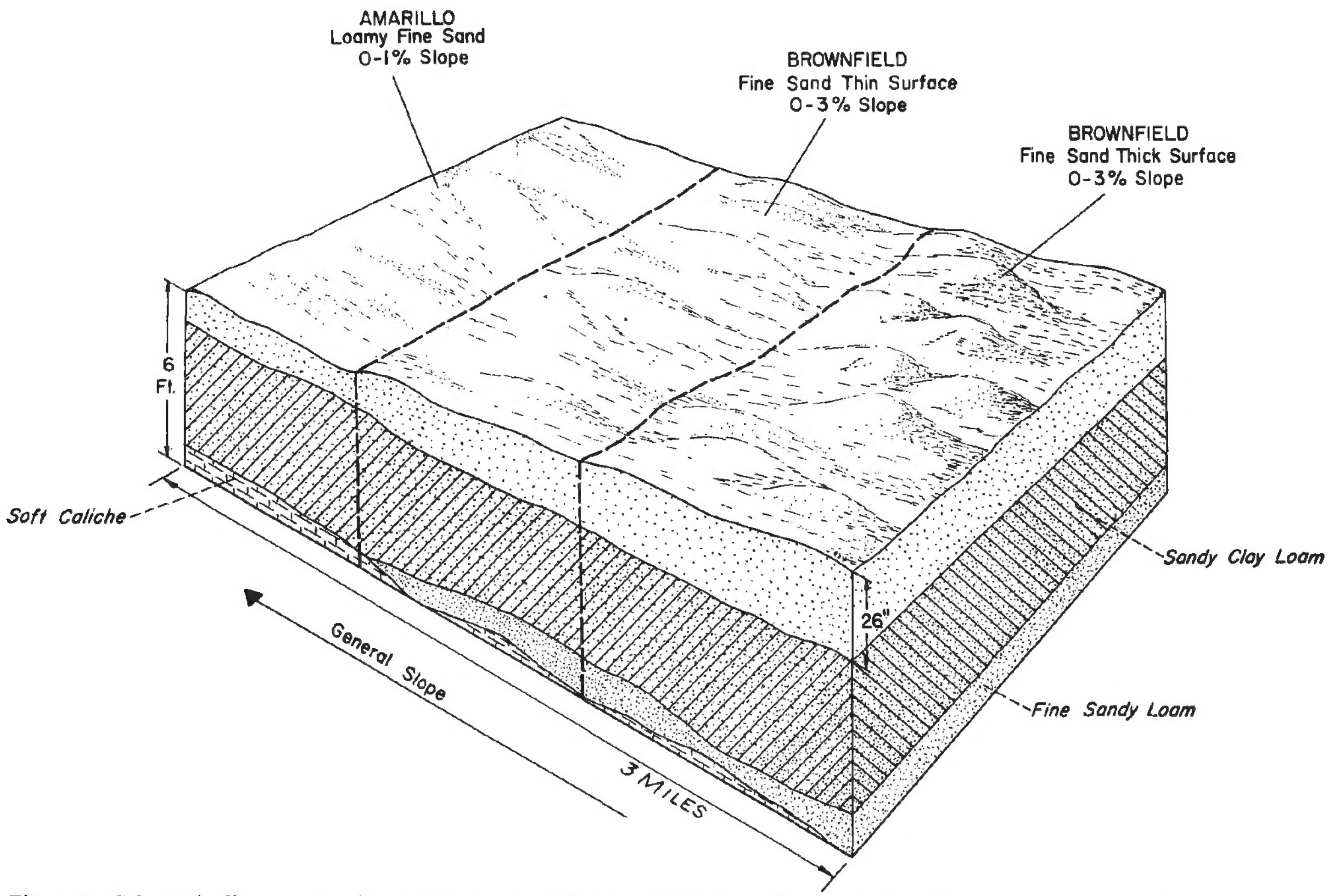

Figure 3.—Schematic diagram showing a typical area of the Brownfield-Amarillo association. The slopes shown are those in the area delineated and do not necessarily conform with the slopes named for the soil mapping units.

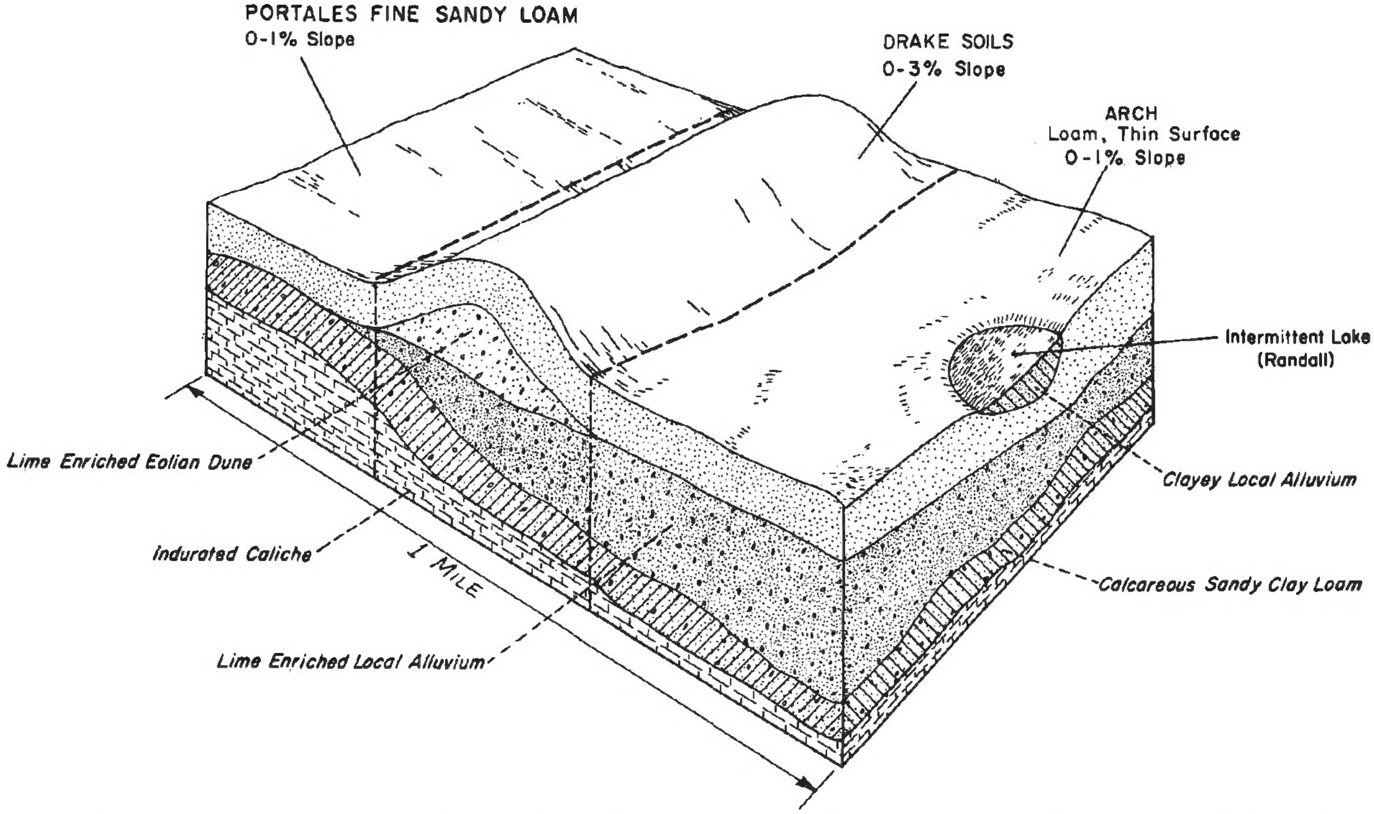

Figure 4.—Schematic diagram showing a typical area of the Portales-Arch association. The slopes shown are those in the area delineated and do not necessarily conform with the slopes named for the soil mapping units.

shallow to moderately deep soils that occur on small ridges within larger areas of Amarillo soils.

About 90 percent of this soil association is in range. The rest is cultivated to cotton and grain sorghum. A thick stand of mesquite and a good cover of black and blue grama, side-oats grama, buffalograss, and three-awn are characteristic of the native vegetation on this association.

Portales-Arch association: Deep and shallow, calcareous loamy soils

The soils in this association occupy a nearly level plain in the west-central part of the county (fig. 4). The association covers 41,000 acres, or about 8 percent of the county. Most of the area consists of Portales loam, Portales fine sandy loam, and Arch loam. The Portales soils are calcareous, moderately deep, and moderately rapidly permeable. The Arch soils are shallower than the Portales and contain more lime.

There are a few small areas of Drake soils, 20 to 80 acres in size. Drake soils contain more lime than Portales and occupy steeper slopes.

About 30 percent of the association is cultivated, mainly to grain sorghum and cotton. Most of this cultivated area is irrigated. The part of the association not cultivated is rangeland that still supports the native plants.

A good stand of side-oats grama, blue and black grama, and buffalograss is characteristic of the native vegetation on the soils of this association.

Spur-Potter association: Deep and very shallow loamy soils

This association is in the three draws that cross the county from northwest to southeast and on the slopes along these draws. The draws were once the headwaters of the Colorado River. The association covers about 7 percent of the county.

This association consists of Spur, Potter, Bippus, and Berthoud soils. The nearly level Spur and Bippus soils are in the bottoms of the draws. The strongly sloping, very shallow, rocky Potter soils are on the sides of the draws, and the Berthoud soils are on foot slopes below the Potter soils (fig. 5). The Mansker and Arvana soils are deeper and are located at higher elevations away from the draws.

Most of this association is in native range. The vegetation in the bottoms of draws is mainly vine-mesquite and buffalograss. Broom snakeweed and scattered plants of sand dropseed and three-awn grow on the sloping Potter soils.

Descriptions of the Soils

In this section each soil series and a profile typical of the series are described. Each mapping unit is then discussed, and if its profile differs from the profile described for the series, these differences are pointed out. The pres-

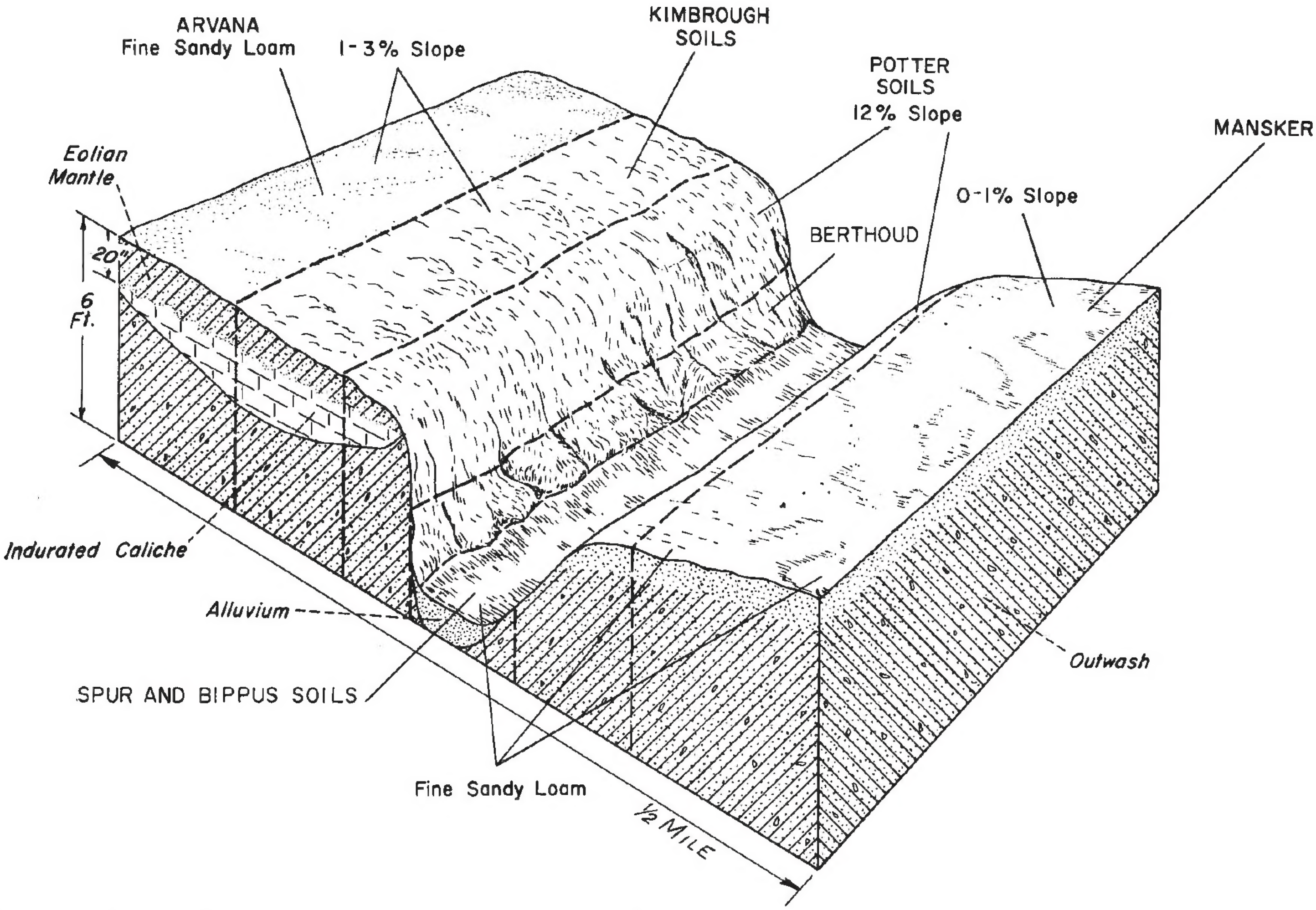

Figure 5.—Schematic diagram showing a typical area of the Spur-Potter association. The slopes shown are those in the area delineated and do not necessarily conform with the slopes named for the soil mapping units.

ent use, and some of the hazards that limit use, are also given for each mapping unit.

The mapping units, and map symbols for these units, are listed in the "Guide to Mapping Units, Capability Units, and Range Sites" at the end of the report. The approximate acreage of each mapping unit is listed in table 1. The location and distribution of the mapping units are shown on the detailed soil map in the back of the report.

Technical descriptions of the soils are given in the section "Genesis, Classification, and Morphology of the Soils."

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Amarillo fine sandy loam, 0 to 1 percent slopes	23,480	4.4
Amarillo fine sandy loam, 1 to 3 percent slopes	6,110	1.0
Amarillo loamy fine sand, 0 to 3 percent slopes	52,530	9.9
Amarillo loamy fine sand, thin solum, 0 to 3 percent slopes	13,520	2.5
Arch loam, thin surface	1,330	.2
Arch complex	880	.2
Arvana fine sandy loam, 0 to 1 percent slopes	8,900	1.7
Arvana fine sandy loam, 1 to 3 percent slopes	870	.2
Arvana fine sandy loam, shallow, 0 to 1 percent slopes	6,160	1.2
Berthoud-Potter complex	3,390	.6
Brownfield fine sand, thin surface	222,890	42.0
Brownfield fine sand, thick surface	70,000	13.2
Brownfield soils, severely eroded	4,740	.9
Brownfield-Tivoli fine sands	16,120	3.0
Drake soils, 1 to 3 percent slopes	1,610	.3
Gomez fine sand	1,120	.2
Gomez loamy fine sand	7,220	1.4
Kimbrough soils	7,240	1.4
Kimbrough-Stegall complex	4,520	.9
Lea loam, shallow, 0 to 1 percent slopes	8,660	1.6
Mansker fine sandy loam, 0 to 1 percent slopes	2,550	.5
Mansker fine sandy loam, 1 to 3 percent slopes	2,330	.4
Mansker loam, 0 to 1 percent slopes	3,090	.6
Portales fine sandy loam, 0 to 1 percent slopes	8,390	1.6
Portales fine sandy loam, 1 to 3 percent slopes	1,660	.3
Portales loam, 0 to 1 percent slopes	6,070	1.1
Randall clay	270	.1
Springer and Brownfield soils, moderately shallow	30,910	5.8
Springer and Brownfield soils, shallow	350	.1
Spur and Bippus soils	1,570	.3
Stegall loam, 0 to 1 percent slopes	950	.2
Stegall loam, shallow, 0 to 1 percent slopes	2,070	.4
Tivoli-Potter complex	970	.2
Zita fine sandy loam, 0 to 1 percent slopes	6,550	1.2
Zita loam, 0 to 1 percent slopes	2,180	.4
Total	531,200	100.0

Amarillo Series

The Amarillo series consists of deep, reddish, moderately permeable, noncalcareous soils. These soils are nearly level to gently sloping. They are among the most extensive soils in the county.

The surface layer ranges from reddish-brown to brown fine sandy loam to loamy fine sand. The thickness is generally about 12 inches but ranges from 8 to 16 inches. This layer is easily worked, is very friable, and takes water readily.

The subsoil is reddish-brown to yellowish-red sandy clay loam, 24 to 60 inches thick. It is moderately permeable. An extensive network of tubes and pores left by decaying roots helps the movement of air and water through the soil. As a result of insect and worm activity, worm channels, cavities, and dark organic stains are generally evident. The underlying material is a pink, soft caliche.

The Amarillo are associated with the Arvana, Brownfield, Portales, and Zita soils. They are less sandy and less red than the Brownfield soils and have a horizon of calcium carbonate that is lacking in those soils. They are redder than the associated calcareous Portales soils that occupy the more nearly level, slightly lower areas.

The Amarillo soils are high in natural fertility and produce moderate to high yields when rainfall is adequate. They are, however, susceptible to water and wind erosion.

The Amarillo soils are used for both dryland and irrigated farming, and large areas are in native range.

Amarillo loamy fine sand, 0 to 3 percent slopes (AmB).—This is the sandiest Amarillo soil in the county. It occupies broad areas in the east-central part and smaller areas throughout the county. A broad, transitional area of it lies between Amarillo fine sandy loam and Brownfield fine sand, thin surface. This Amarillo soil occupies smoother, lower lying areas than the associated sandier Brownfield soil.

The surface layer is reddish brown to yellowish red and is 10 to 14 inches thick. Most of this soil has been deep plowed to a depth of 16 to 24 inches. As a result, some of the sandy clay loam subsoil has been mixed with the sandy surface soil. This addition of clay to the plow layer has made tillage a more effective way of controlling wind erosion.

Included with this soil are a few small areas of Brownfield fine sand, thin surface, and minor areas of Springer and Brownfield soils, moderately shallow. These soils make up less than 5 percent of the areas.

This soil is productive, but the risk of wind erosion is high. Most areas are cultivated. The main crops, cotton and grain sorghum, are grown on both dry-farmed and irrigated areas. (Capability unit IVe-1 (dryland); capability unit IIIe-1 (irrigated); Sandy Land range site.)

Amarillo loamy fine sand, thin solum, 0 to 3 percent slopes (AnB).—This soil is of minor extent and occupies low swales within larger areas of Amarillo loamy fine sand, 0 to 3 percent slopes. The subsoil is darker than that of the surrounding soil, and the depth to soft caliche is 26 to 30 inches. In most areas the slope ranges from 1 to 3 percent.

This soil is productive but is highly susceptible to wind erosion. It is cultivated along with the surrounding, larger areas of Amarillo loamy fine sand. (Capability unit IVe-1 (dryland); capability unit IIIe-1 (irrigated); Sandy Land range site.)

Amarillo fine sandy loam, 0 to 1 percent slopes (AfA).—This is the most extensive fine sandy loam in the county. It has a brown surface layer, 8 to 10 inches thick.

Included with this soil are small, circular, lower lying areas of Zita fine sandy loam, 0 to 1 percent slopes, of Portales fine sandy loam, 0 to 1 percent slopes, of Amarillo loamy fine sand, 0 to 3 percent slopes, and of Arvana fine sandy loam, 0 to 1 percent slopes.

Some areas of this fine sandy loam have been cultivated longer than some of the sandier soils in the county. Consequently, the soil has been winnowed by the wind in many places, and much of the clay and silt in the plow layer has been blown away. As a result, the upper 4 to 8 inches of the surface soil are sandier than originally.

This soil is the most productive in the county for irrigated farming; however, soil tests show that it is low in nitrogen and phosphorus. Cotton, grain sorghum, legumes, and small grain produce good yields under dryland farming or irrigation. (Capability unit IIIe–1 (dryland); capability unit IIe–4 (irrigated); Mixed Land range site.)

Amarillo fine sandy loam, 1 to 3 percent slopes (AfB).—This soil is of minor extent. It occupies low ridges within larger areas of Amarillo fine sandy loam, 0 to 1 percent slopes. It is slightly redder and has a thinner surface layer and a thinner subsoil than Amarillo fine sandy loam, 0 to 1 percent slopes.

If this soil is cultivated, the hazards of sheet and gully erosion and of wind erosion are moderate. (Capability unit IIIe–1 (dryland); capability unit IIIe–2 (irrigated); Mixed Land range site.)

Arch Series

The soils of the Arch series are light brownish gray, shallow, and highly calcareous. These soils are nearly level and occur in the west-central part of the county in large flats or depressions that are high in lime.

The surface layer is light brownish gray, strongly calcareous, and 4 to 10 inches thick. At a depth of 10 to 20 inches, the subsoil is a chalky clay loam that has little structure and many soft, rounded lumps of pure lime. Most of the roots are in the darker surface layer.

These soils have formed in old wind-sorted sediments or lake sediments that were enriched by lime from ground water or by runoff from adjacent limy areas.

The Arch soils are associated with the Mansker and the Portales. They are lighter colored than the Mansker and are lighter colored, higher in lime, and shallower than the Portales.

Arch loam, thin surface (Aa).—The high content of lime in this soil causes it to be highly susceptible to wind erosion under cultivation. High lime soils do not readily form a cloddy surface that resists wind erosion. Emergency tillage is generally not effective. Farmers must rely on good plant cover to control blowing.

If irrigated and fertilized, this soil produces moderate yields of cotton. Grain sorghum is susceptible to chlorosis, a yellowing of the leaves caused by an iron deficiency that reduces yields. (Capability unit IVes–1 (dryland); capability unit IIIes–1 (irrigated); High Lime range site.)

Arch complex (Ac).—About 60 percent of this complex of soils consists of Arch loam, thin surface; about 30 percent consists of Portales loam, 0 to 1 percent slopes; and about 10 percent consists of Mansker loam, 0 to 1 percent slopes. The areas of these soils were too closely associated or intricately mixed to be mapped separately at the scale used. Most of this complex is in one large area in the northwestern part of the county.

Generally, the very slightly elevated ridges consist of Arch soils, and the lower lying areas consist of Portales soils. The difference in elevation is only a few inches. In several places that have no change in elevation and no noticeable difference in vegetation, the soils in this complex range from Arch to Portales and to Arch again within 20 feet.

If irrigated, these calcareous soils produce good yields of cotton. Grain sorghum, though, is susceptible to chlorosis, or yellowing of the leaves. Because these soils contain much lime, the clods formed by tillage are not stable. They break down readily, and much of the soil material is blown away. Vegetation should be left on cultivated areas to control wind erosion. Level-border, level-furrow, or sprinkler irrigation should be used. (Capability unit IVes–1 (dryland); capability unit IIIes–1 (irrigated); High Lime range site.)

Arvana Series

The Arvana series consists of reddish, shallow to moderately deep, noncalcareous, moderately sandy soils. They occur throughout the county on nearly level to gently sloping plains.

The surface layer is a reddish-brown to brown fine sandy loam, about 12 inches thick. This layer is easily worked, is very friable, and takes water readily.

The subsoil is a yellowish-red to reddish-brown sandy clay loam, 8 to 24 inches thick. It is noncalcareous and moderately permeable. The subsoil is underlain at a depth of 12 to 36 inches by hard, rocklike, platy caliche.

The Arvana soils have developed in a thin sandy mantle that was deposited by wind over preexisting caliche. The hard caliche rocks have smooth and rounded tops, but their bottoms are concretionary or knobby.

The Arvana are associated with the Amarillo and Kimbrough soils. They are shallower than the Amarillo and are deeper and redder than the Kimbrough.

These soils are moderately permeable and are well drained. They have a good water-holding capacity and are high in natural fertility. They are susceptible, however, to both wind and water erosion. Arvana soils are used for both dryland and irrigated farming. Large areas are in native range.

Arvana fine sandy loam, 0 to 1 percent slopes (AvA).—This soil occurs throughout the county in areas that range from 40 to 80 acres. It is associated with Amarillo fine sandy loam, 0 to 1 percent slopes.

The surface layer is brown to reddish-brown fine sandy loam, about 8 inches thick. The depth to hard rock ranges from 24 to 36 inches.

Included with this soil are small areas of Arvana fine sandy loam, shallow, 0 to 1 percent slopes.

Arvana fine sandy loam, 0 to 1 percent slopes, is very productive under irrigation. Soil tests, however, show that it is low in nitrogen and phosphorus. If dry-farmed or irrigated, it produces good yields of cotton, grain sorghum, legumes, and small grain.

Arvana fine sandy loam, 0 to 1 percent slopes, is moderately susceptible to blowing. Many areas that are associated with Amarillo fine sandy loam have been cultivated a long time. Consequently, much of the clay and silt has been blown away, and the plow layer is coarser than it was originally. (Capability unit IIIe–1 (dryland); capability unit IIe–4 (irrigated); Mixed Land range site.)

Arvana fine sandy loam, 1 to 3 percent slopes (AvB).—This soil is of minor extent and occupies low ridges within larger areas of Arvana fine sandy loam, 0 to 1 percent slopes. In places it has a thinner surface layer and is slightly lighter colored throughout the profile than the Arvana soils on the gentler slopes. It is also slightly shallower in places; the average thickness is 24 to 30 inches. Most of the slopes are about 2 percent.

If this soil is cultivated, the hazards of sheet and gully erosion and of wind erosion are moderate. (Capability unit IIIe–1 (dryland); capability unit IIIe–2 (irrigated); Mixed Land range site.)

Arvana fine sandy loam, shallow, 0 to 1 percent slopes (AwA).—This shallow soil differs from Arvana fine sandy loam in being underlain by hard caliche at a depth of about 12 to 20 inches.

The slight depth of this soil is a very limiting factor. Often the soil will not hold all the rainfall. Some rain is lost as runoff, and some enters the cracks of the hard caliche and goes beyond the zone that most crop roots can penetrate.

If cultivated, this soil is moderately susceptible to wind erosion. Crop residues or a green cover crop should be left on the soil during the critical period of soil blowing in spring. In cultivated areas many rocks are scattered over the surface. (Capability unit IVe–3 (dryland); capability unit IIIe–4 (irrigated); Mixed Land range site.)

Berthoud Series

The Berthoud series consists of brown to grayish-brown, moderately deep, moderately permeable soils.

The surface layer is brown to dark-brown loam or fine sandy loam, 8 to 16 inches thick. The subsoil is yellowish-brown clay loam that contains free lime. The parent material is a very pale brown clay loam that contains much free lime. It occurs at a depth of 30 to 48 inches.

These soils occupy long, very narrow areas along the foot slopes of the draws and below the higher lying Potter soils. They follow the slope contour of the draws, just above the Spur and Bippus soils, which occupy the bottoms of the draws. They have developed from material washed from higher lying areas.

The Berthoud soils are associated with the Mansker, which are shallower, and the Spur, which are darker and deeper. In Yoakum County the Berthoud soils are mapped only in a complex with the Potter soils and are of minor extent.

Berthoud-Potter complex (Be).—This mapping unit consists of a complex of soils that were too closely associated or intricately mixed to be mapped separately. These soils occupy the steep slopes of the draws that cross Yoakum County. The Potter soils occupy the narrow ledges or caliche caps that are near the top of the slopes and on the steeper areas. These soils normally make up about 45 percent of the acreage. Berthoud soils occupy the lower lying foot slopes and the less sloping tributary drainageways. They generally make up about 45 percent of this complex. Areas of Arvana, Mansker, and Kimbrough soils make up about 10 percent of the complex.

The complex consists of brown to dark grayish-brown, very shallow to moderately deep soils that are underlain by soft to hard caliche. The slopes range from 5 to 12 percent but in most places are about 8 percent.

These soils have shallow gullies and some alluvial fans at the base of the slopes. The vegetation is a sparse stand of short grasses and a moderate stand of broom snakeweed.

Most areas of Arvana and Kimbrough soils have been moderately eroded by both wind and water. Because the soils of this complex have steep slopes and are highly susceptible to both wind and water erosion, they are not suited to cultivation. They are best suited to perennial grass. (Capability unit VIs–1 (dryland); not suitable for irrigation; Shallow Land range site.)

Bippus Series

This series consists of grayish, friable, moderately permeable soils that have no free lime to a depth of 18 inches.

The surface layer ranges from very dark brown to grayish brown in color and from clay loam to loam in texture. The subsoil is brown to light-brown clay loam, 10 to 20 inches thick, and it contains free lime. It is underlain by a lighter colored clay loam that contains a large amount of free lime.

These soils occupy the bottoms of ancient drains or draws that cross the county from northwest to southeast. Runoff is slow to moderate, and internal drainage is moderate.

In this county the Bippus soils are mapped only with the Spur soils as an undifferentiated unit.

Brownfield Series

The Brownfield series consists of deep, noncalcareous, moderately permeable sandy soils. These soils are nearly level to undulating. They are the most extensive soils in Yoakum County.

The surface layer is yellowish-red to reddish-yellow fine sand, 10 to 40 inches thick. This layer is very friable and loose, is easily worked, and takes water readily.

The subsoil is red, friable, moderately permeable, noncalcareous sandy clay loam, 40 to 70 inches thick.

The parent material ranges from reddish, noncalcareous light sandy clay loam to loamy fine sand. The Brownfield soils do not have distinct horizons of calcium carbonate, but in some places they are underlain by soft caliche. This caliche is thought to be a relict carbonate layer on which windblown material was deposited.

The Brownfield soils are associated with the Amarillo, the Gomez, and the Tivoli soils. They occupy gently rolling slopes above the smoother Amarillo and Gomez soils and below the dunelike Tivoli soils.

The Brownfield soils are deeper and sandier than the Amarillo soils. They do not have an accumulation of calcium carbonate as do the Amarillo soils. They are redder and less permeable than the Gomez soils. A sandy clay loam subsoil distinguishes them from the Tivoli soils, which are sandier throughout the profile.

Cultivated areas of the Brownfield soils are highly susceptible to wind erosion. If they are not protected by vegetation, the top few inches of the surface soil is continually shifted by the wind. The wind removes a small amount of silt, clay, and organic matter, and the soil becomes sandier and less fertile each year.

The Brownfield soils are used for both cultivated crops and range.

Brownfield fine sand, thin surface (Bs).—This is the most extensive soil in the county; it makes up 42 percent of the county. Slopes range from 0 to 3 percent.

The surface layer ranges from yellowish red to reddish yellow in color, and from 10 to 18 inches in thickness.

Included with this soil, as mapped, are a few small areas of Brownfield fine sand, thick surface.

Brownfield fine sand, thin surface, is productive, but the risk of wind erosion is high. For several years, farmers have deep plowed this soil and mixed the sandy clay loam of the subsoil with the fine sand surface soil. This practice, if used with other good management practices, helps to reduce or to control wind erosion. Sprinkler irrigation is the only efficient way to apply water. (Capability unit IVe-2 (dryland); capability unit IIIe-5 (irrigated); Sandy Land range site.)

Brownfield fine sand, thick surface (Br).—This soil makes up about 14 percent of the county. It occurs along the northern edge and in areas of 400 to 600 acres throughout the county.

The reddish-yellow fine sand surface layer ranges from 18 to 40 inches in thickness, but it is generally less than 30 inches thick. It is thicker than that of Brownfield fine sand, thin surface, and is more susceptible to wind erosion.

Included with this soil are a few small, subdued dunes consisting of Tivoli fine sand. Small areas of Brownfield fine sand, thin surface, on the tops of ridges and on slopes facing west are also included.

Brownfield fine sand, thick surface, is highly susceptible to wind erosion. Deep plowing is not practical because, in most places, the sandy surface layer is so thick that not enough clayey subsoil can be plowed up to mix with it. Keeping a continuous cover of growing plants or stubble on this soil is the only way to control wind erosion. (Capability unit VIe-1 (dryland); capability unit IVe-1 (irrigated); Deep Sand range site.)

Brownfield soils, severely eroded (Bt3).—All of the surface soil has been removed from as much as 80 percent of the area of the soils in this mapping unit, and the red sandy clay loam subsoil has been exposed. The slopes range from 0 to 3 percent. These soils are of minor extent and occur in abandoned fields throughout the county.

Other characteristics of these soils are (1) blowout holes where all of the surface soil and part of the subsoil have been removed; (2) dunes and hillocks, as much as 6 feet in height and 10 to 50 feet in diameter at the base; and (3) dunes, 10 to 15 feet high and 50 to 100 feet wide, around the field boundary. In some places there may be two or three fences, one above the other, covered by these field-boundary dunes. Other areas form a complex of blowouts and dunes. The dunes in these areas are circular, occupy as much as 20 percent of the acreage, and are generally covered by shin oak and a few tall grasses; some, however, are bare and are moving from southwest to northeast. The swept-off areas are often bare except in local low spots that receive extra water (fig. 6). Hard caliche rocks are exposed in places.

Areas of these soils are nonarable. The sand could be extensively leveled and redistributed, but these practices are costly and may not be practical. The best practice is to establish perennial grass, but this is difficult. (Capability unit VIe-1 (dryland); not suitable for irrigation; Deep Sand range site.)

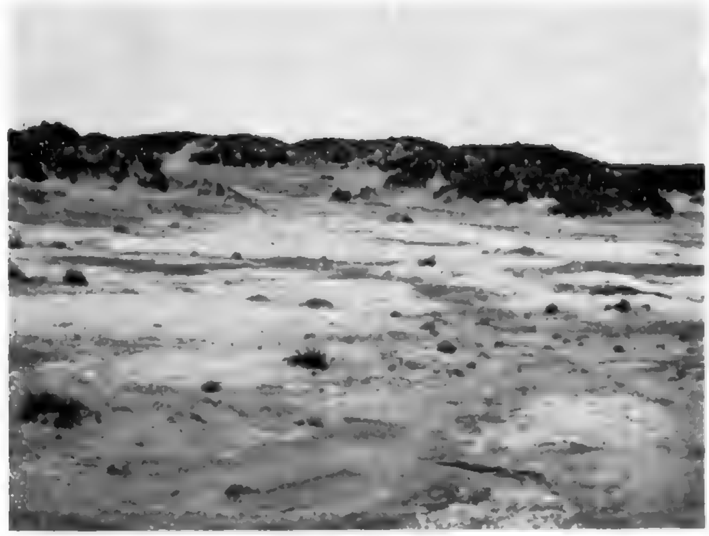

Figure 6.—A typical area of Brownfield soils that are severely eroded because of improper use.

Brownfield-Tivoli fine sands (Bv).—This complex consists of very sandy soils that were too closely associated or too intricately mixed to be mapped separately. These soils are in a band, 4 to 6 miles wide, across the northern edge of the county. Throughout the area they are undulating to rolling and in places are on distinct dunes, 3 to 30 feet high and 50 to 100 feet in diameter. They are in rangeland that supports tall grasses, such as bluestems and dropseeds. Invading plants include yucca, sandsage, and shin oak.

These soils are not suited to cultivation because their surface soil is loose and sandy. (Capability unit VIIe-1 (dryland); not suitable for irrigation; Deep Sand range site.)

Drake Series

The soils of the Drake series are light colored, strongly calcareous, and moderately rapidly permeable. They make up the dunes on the east and northeast sides of ancient lakes, or playas. There are six very prominent dunes and many smaller ones. These dunes are locally called chalk hills. The Drake soils are of minor extent.

The surface layer is gray to grayish-brown loam or fine sandy loam, 6 to 10 inches thick. The subsoil is a white, strongly calcareous, soft chalky material.

These soils have developed from material blown from the dry, strongly calcareous playas.

The Drake soils are associated with the lower lying Arch and Portales soils. They have steeper slopes than the Arch and are lighter colored and more strongly calcareous than the Portales soils.

The Drake soils are highly susceptible to wind erosion.

Drake soils, 1 to 3 percent slopes (DrB).—These soils generally have crescent-shaped slopes of more than 2 percent. In a few places, however, they have slopes greater than 3 percent. They are of minor extent in the county.

Because of slope, these soils are moderately susceptible to water erosion. They are highly susceptible to wind erosion.

Since the smaller areas of these soils are associated with less sloping and more productive soils, they are often cultivated. Chlorosis, or a yellowing of the leaves of plants grown on these soils, is a problem. Plowing to form clods for erosion control is not feasible on these soils. Because of the high content of lime in the soils, the clods are not stable. (Capability unit IVes–1 (dryland); capability unit IIIes–1 (irrigated); High Lime range site.)

Gomez Series

The Gomez series consists of moderately deep, moderately rapidly permeable, calcareous sandy soils developed from wind-deposited material. These soils have concave slopes of less than 2 percent. They are not extensive.

The surface layer ranges from brown to dark grayish-brown loamy fine sand to fine sand, 10 to 24 inches thick. This layer is easily worked, very friable, and takes water readily.

The subsoil is light gray to very dark brown, calcareous fine sandy loam, 10 to 24 inches thick. It is moderately rapidly permeable.

The parent material is a white to light brownish-gray, very strongly calcareous fine sandy loam.

The Gomez soils are associated with the Portales, which are less sandy, and the Amarillo and Brownfield, which are less permeable.

Gomez soils are used for both dryland and irrigated farming.

Gomez fine sand (Gf).—The surface layer is fine sand, 18 to 24 inches thick. Cultivated areas are calcareous to the surface and are highly susceptible to wind erosion. Surface roughening alone will not control wind erosion. Because of the high lime content and the sandy texture of the soil, the clods are not stable. (Capability unit VIe–3 (dryland); capability unit IVe–1 (irrigated); Sandy Land range site.)

Gomez loamy fine sand (Gl).—The surface layer of this soil is thinner and darker colored than that of Gomez fine sand. It is also less sandy and less calcareous. This soil is highly susceptible to wind erosion. (Capability unit IVe–1 (dryland); capability unit IIIe–1 (irrigated); Sandy Plains range site.)

Kimbrough Series

In the Kimbrough series are brown to reddish-brown, very shallow, nearly level, noncalcareous soils. These soils are 4 to 10 inches thick over a layer of thick, hard, platy caliche. Their total acreage is small.

The surface layer ranges from loam to fine sandy loam in texture.

The Kimbrough soils are darker colored and less calcareous than the Potter soils and are underlain by harder caliche. They are shallower and less red than the Arvana soils. They are less slowly permeable than the Stegall soils, which range from 12 to 36 inches in depth to hard rock.

The Kimbrough soils are not suited to cultivation.

Kimbrough soils (Km).—These soils are too shallow to produce crops successfully (fig. 7). If they are cultivated, many small hard rocks are on the surface. (Capability unit VIIs-1 (dryland); not suitable for irrigation; Shallow Land range site.)

Figure 7.—**Kimbrough soils, showing the 6- to 10-inch surface layer over a thick bed of caliche.**

Kimbrough-Stegall complex (Ks).—This complex consists of areas of Kimbrough soils and Stegall soils that were too closely associated or intricately mixed to be mapped separately at the scale used. The Kimbrough soils make up about 70 percent of this complex, and the Stegall soils, about 30 percent. This complex is of minor extent.

The Stegall soils are in the very slight swales within areas of the higher lying Kimbrough soils. They are noncalcareous and are deeper, darker, and more slowly permeable than the Kimbrough soils. The slopes of the Kimbrough soils are less than 2 percent. (Capability unit VIIs–1 (dryland); not suitable for irrigation; Shallow Land range site.)

Lea Series

The Lea series consists of grayish-brown to dark grayish-brown, moderately permeable, calcareous soils, 14 to 20 inches thick. These soils have developed over hard, rocklike caliche. They are smooth and nearly level and are of minor extent.

The surface layer is calcareous loam, 8 to 10 inches thick. The subsoil is pale-brown clay loam that is strongly calcareous.

The Lea soils are shallower than the Portales. Unlike the Mansker soils, Lea soils have hard rocks under the subsoil.

A minor acreage of the Lea soils is cultivated. Most areas are in native range.

Lea loam, shallow, 0 to 1 percent slopes (LeA).—This soil is associated with deeper soils of other series. It is mainly in the west-central part of the county. The shallow depth limits the capacity of this soil to hold water and plant nutrients. Cultivated areas are susceptible to wind erosion. (Capability unit IVe–4 (dryland); capability unit IIIe–4 (irrigated); Mixed Plains range site.)

Mansker Series

In this series are brown to dark grayish-brown, calcareous, shallow, moderately permeable soils, 16 to 20 inches deep over soft caliche. These soils have nearly level to gentle slopes that range from 0 to 3 percent. They are of minor extent.

The surface layer is loam or fine sandy loam, 8 to 12 inches thick. The subsoil is strongly calcareous, pale-brown to gray clay loam. The parent material is very strongly calcareous, pale-brown to white clay loam.

The Mansker soils are shallower and lighter colored than the Portales and do not have a layer of hard caliche as do the Lea.

Some areas of Mansker soils are used for cotton and grain sorghum under both dryland and irrigated farming.

Mansker fine sandy loam, 0 to 1 percent slopes (MfA).—This shallow soil has a brown to grayish-brown, calcareous fine sandy loam surface layer, 6 to 10 inches thick. It occurs in small areas throughout the county.

Tillage will not control wind erosion, because the high content of lime in the soil prevents the formation of enough stable clods. Chlorosis, or a yellowing of the leaves caused by lime, is a problem on this soil. (Capability unit IVe–3 (dryland); capability unit IIIe–4 (irrigated); Mixed Plains range site.)

Mansker fine sandy loam, 1 to 3 percent slopes (MfB).—This soil is more sloping, lighter colored, and 3 to 4 inches shallower than Mansker fine sandy loam, 0 to 1 percent slopes. Because of the slope, slight depth, and risks of both wind and water erosion, the use of this soil is limited. (Capability unit IVe–3 (dryland); capability unit IIIe–4 (irrigated); Mixed Plains range site.)

Mansker loam, 0 to 1 percent slopes (MkA).—The surface layer of this soil is a brown to dark grayish-brown loam, 6 to 10 inches thick. This soil is limited in use because it is shallow and has a relatively low water-holding capacity. It occupies small areas in association with Portales loam, which is deeper. (Capability unit IVe–4 (dryland); capability unit IIIe–4 (irrigated); Mixed Plains range site.)

Portales Series

The Portales series consists of moderately dark, moderately deep, moderately rapidly permeable soils that are friable and calcareous. The slopes range from 0 to 3 percent but are normally less than 2 percent. These soils are fairly extensive throughout the county.

The surface layer is pale-brown to dark grayish-brown, calcareous fine sandy loam or loam, 8 to 16 inches thick. The subsoil is calcareous clay loam that is lighter in color than the surface layer and 8 to 24 inches thick. The parent material is very strongly calcareous, white to light brownish-gray clay loam, 24 to 36 inches below the surface.

The Portales soils are associated with the Mansker, Zita, Amarillo, and Arch. They are deeper than the Mansker and are deeper and less limy than the Arch soils. They are shallower and less red than the Amarillo soils, which are noncalcareous. The Portales soils are lighter colored and more limy than the Zita soils.

Portales fine sandy loam, 0 to 1 percent slopes (PfA).—This soil has a surface layer of grayish-brown to dark grayish-brown fine sandy loam. The parent material is white to pale-brown, very strongly calcareous clay loam that occurs at a depth of 24 to 36 inches. This is the most extensive soil in the Portales series.

In some places this soil has 3 to 6 inches of loamy fine sand in the plow layer. The texture of this layer may be caused by two kinds of erosion—the removal of silt and clay by the wind or the accumulation of sand particles that have blown from higher lying, sandier areas to the slightly depressed areas of this soil.

This soil is used for cotton and grain sorghum under both dryland and irrigated farming. (Capability unit IIIe–2 (dryland); capability unit IIe–5 (irrigated); Mixed Plains range site.)

Portales fine sandy loam, 1 to 3 percent slopes (PfB).—The surface layer of this gently sloping soil is thinner, lighter colored, and more calcareous than that of Portales fine sandy loam, 0 to 1 percent slopes. Most areas have slopes of less than 2 percent. In some places small gullies have been formed. (Capability unit IIIe–2 (dryland); capability unit IIIe–3 (irrigated); Mixed Plains range site.)

Portales loam, 0 to 1 percent slopes (PmA).—The surface layer of this soil is brown to grayish-brown, calcareous loam, 8 to 18 inches thick. The subsoil is lighter colored and more calcareous than the surface layer and is 10 to 20 inches thick. The parent material is white to pale-brown, very strongly calcareous, soft chalky earth. This soil is nearly level and smooth. It occupies broad areas in the west-central part of the county. (Capability unit IIIce–2 (dryland); capability unit IIe–2 (irrigated); Mixed Plains range site.)

Potter Series

The Potter series consists of light grayish-brown, very shallow, calcareous soils that overlie beds of soft or slightly hard caliche. These soils occupy the steep slopes of the draws that cross the county.

The Potter soils are similar to the Kimbrough and Lea. They are more calcareous, are lighter colored, and are underlain by less hard caliche than the Kimbrough soils. They are shallower and lighter colored than the Lea soils.

In this county the Potter soils are mapped only in complexes with the Berthoud soils and the Tivoli soils.

Randall Series

In this series are gray to dark-gray, poorly drained clayey soils on the floors of playas (lakes). These soils occupy small areas, 2 to 4 acres in size, mainly in the west-central part of the county. They are of minor extent.

The surface layer is gray to dark-gray clay, 10 to 30 inches thick. The subsoil is dark-gray, tough plastic clay.

The associated soils are the Kimbrough, Arvana, and Amarillo. The Randall soils are normally cultivated along with the surrounding soils.

Randall clay (Rc).—This soil is farmed in some areas. Yields are good in years when moisture is adequate but not excessive. The slopes are less than 1 percent. A gilgai, or buffalo-wallow relief, is common where these soils are in native range. Because of floods and the consequent drowning of crops, this soil is extremely limited in use. (Capability unit VIw–1 (dryland); not suitable for irrigation; Deep Hardland range site.)

Springer Series

The soils of the Springer series are loose, sandy, moderately rapidly permeable, and noncalcareous. They are gently sloping. They are underlain by hard caliche at a depth of 16 to 36 inches.

The subsoil is a red to yellowish-red loam to fine sandy loam.

These soils are used for both cultivated crops and range. Cultivated areas are highly susceptible to wind erosion. If not protected by vegetation, they are subject to a continual shifting of the upper few inches by wind.

In this county the Springer soils are mapped only in undifferentiated units with Brownfield soils. They have less clay in the subsoil than the Brownfield soils.

Springer and Brownfield soils, moderately shallow (Sb).—These soils occupy areas of 40 to 60 acres throughout the county. They resemble Brownfield fine sand, thin surface, except that they are underlain at a depth of 20 to 36 inches by hard caliche rock and have a fine sandy loam subsoil in some areas.

These soils are closely associated with Brownfield fine sand, thin surface, and Springer and Brownfield soils, shallow. They usually occupy ridges above Brownfield fine sand, thin surface.

These soils are productive, but the risk of wind erosion is high. Since they are underlain by hard rock, they must be deep plowed with caution.

During the period of plowing in spring, these soils are subject to shifting of the surface soil and the loss of finer textured, more fertile particles of silt and clay. The only efficient way to apply water is by sprinkler irrigation. (Capability unit IVe–2 (dryland); capability unit IIIe–5 (irrigated); Sandy Land range site.)

Springer and Brownfield soils, shallow (Sg).—These soils are very inextensive and occupy small areas within larger areas of Springer and Brownfield soils, moderately shallow. Unlike the associated Brownfield soils, they are underlain by hard caliche at a depth ranging from 10 to 20 inches.

These areas of shallow soils generally have been deep plowed along with the surrounding areas. As a result, they have flat, rocklike caliche fragments on the surface.

These soils are highly susceptible to wind erosion. They are not suited to cultivation and should be planted to perennial grasses. (Capability unit VIe–2 (dryland); not suitable for irrigation; Sandy Land range site.)

Spur Series

The soils of this series are brown to very dark grayish-brown, friable, and calcareous. They are on the floors of the ancient draws that cross the county from northwest to southeast. These draws were once the headwaters of the Colorado River but do not now carry runoff. These soils are of minor extent.

The surface layer ranges from very dark grayish brown to light brown in color and from clay loam to fine sandy loam in texture. It ranges from 12 to 30 inches in thickness and is calcareous.

The subsoil is a pale-brown to grayish-brown clay loam. This layer is calcareous, friable, and moderately permeable. It is from 20 to 50 inches thick.

The parent material is a white to grayish-brown, very strongly calcareous clay loam.

The main associated soils are the Potter and the Mansker. The Potter are very shallow soils that occupy the steep slopes on the edges of the draws. The Mansker are shallow soils that also occupy the edges of the draws.

In this county the Spur soils were mapped only in association with the Bippus as an undifferentiated unit. The Bippus soils are noncalcareous in the surface layer and more clayey throughout the profile than the Spur soils.

Spur and Bippus soils (Sp).—This unit consists of areas of Spur and Bippus soils that were so intermixed that it was not practical to map them separately. Generally, the Spur soils are calcareous to the surface, and the Bippus are not.

As a result of the winnowing by wind and the accumulations of sand from nearby sandy soils, some areas have 3 to 6 inches of loamy fine sand in the plow layer. The slope is less than 1 percent.

These are fertile soils that receive water from adjoining areas. They produce good yields of cotton, grain sorghum, and grass. The risk of wind erosion is moderate. (Capability unit IIIe–1 (dryland); capability unit IIe–4 (irrigated); Bottom Land range site.)

Stegall Series

This series consists of brown to dark-brown, shallow to moderately deep, slowly permeable soils that are noncalcareous. These soils have developed over hard, rocklike caliche that is at a depth of 16 to 36 inches. They are of minor extent.

The surface layer is brown to dark-brown, noncalcareous loam, 4 to 12 inches thick.

The subsoil is dark-brown to dark grayish-brown, noncalcareous heavy clay loam, 8 to 32 inches thick. This layer has blocky structure and is slowly permeable. Because of the clay loam texture and blocky structure, the movement of air and water through the soil is slow and root penetration is restricted.

These soils are less permeable and are less red than the Arvana soils.

Stegall loam, shallow, 0 to 1 percent slopes (SuA).—This soil is underlain by hard caliche at a depth of 16 to 20 inches. Most areas are in swales surrounded by higher lying Kimbrough soils. This soil is of limited use because it is shallow and low in its capacity to hold available water. It is susceptible to slight wind erosion, if cultivated. (Capability unit IVe–4 (dryland); capability unit IIIe–4 (irrigated); Shallow Land range site.)

Stegall loam, 0 to 1 percent slopes (StA).—This is a moderately deep soil that is underlain by hard, rocklike caliche at a depth of 20 to 36 inches. It occupies areas in the west-central part of the county in low swales surrounded by higher lying Kimbrough, Mansker, and Zita soils.

This is a fertile soil that produces good yields of cotton and grain sorghum, except when water is scarce. Because the soil is slowly permeable and does not supply water rapidly enough to the roots in dry weather, crops are likely to wilt. (Capability unit IIIce–1 (dryland); capability unit IIe–1 (irrigated); Deep Hardland range site.)

Tivoli Series

The soils of the Tivoli series are deep, light-colored loose sands that were deposited by wind. These soils occur in a band, 4 to 6 miles wide, on the northern edge of the county, and also along ancient drains.

The Tivoli are undulating to billowy soils on stabilized dunes, 2 to 12 feet high, and as much as 200 feet in diameter at the base.

The surface layer is light brownish-gray to brown thick fine sand, 6 to 10 inches thick. This layer is loose sand that takes water rapidly.

The underlying material is very pale brown to yellow fine sand, 30 to 60 inches thick.

Because the hazard of wind erosion is high, the Tivoli soils are not suited to cultivation. In this county they are mapped in complexes with the Brownfield soils and the Potter soils. The Brownfield are smoother, lower lying soils adjacent to or intermingled with the Tivoli.

Tivoli-Potter complex (Tx).—About 75 percent of this complex of soils consists of fine sand that accumulated over Potter material; 20 percent consists of Potter soils; and 5 percent consists of Mansker fine sandy loam, 1 to 3 percent slopes. These areas were too closely associated or intricately mixed to be mapped separately. The accumulations of fine sand on the areas of this complex range from 1 to 5 feet in thickness. They are mainly in areas covered with native vegetation that adjoin areas of cultivated sandy soils.

These soils occupy slopes along ancient drains (fig. 8). They are associated with the coarse-textured soils of the Brownfield and Amarillo series.

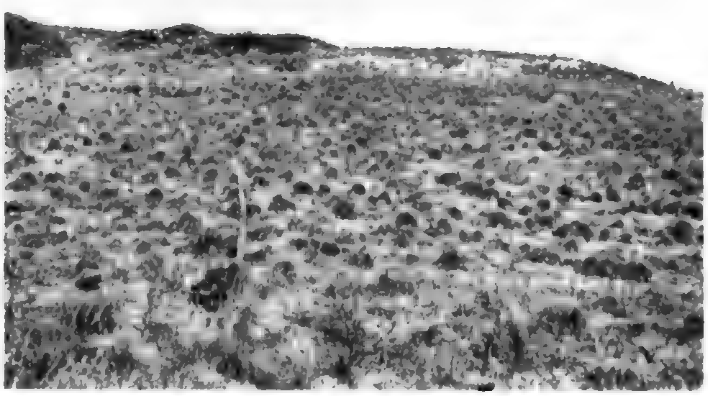

Figure 8.—**A steeply sloping area of the Tivoli-Potter complex on the edge of one of the draws that cross the county.**

Because these soils are thin, or have steep slopes and are highly susceptible to wind and water erosion, they are not suited to cultivation. They are best suited to perennial grasses. (Capability unit VIIe–2 (dryland); not suitable for irrigation; Sandy Land range site.)

Zita Series

The soils of the Zita series are brown, moderately deep, moderately permeable, and noncalcareous. These are nearly level soils that occur in small areas within larger areas of Amarillo and Portales soils. They are of minor extent.

The surface layer is brown to dark grayish-brown fine sandy loam or loam, 8 to 20 inches thick. It has subangular blocky structure.

The subsoil is grayish-brown to dark-brown, calcareous clay loam, 8 to 16 inches thick.

The parent material is pink to white, strongly calcareous clay loam. It is 24 to 36 inches below the surface.

These soils are shallower and less red than the Amarillo soils. They are darker than the Portales soils, which are calcareous to the surface. Most areas of the Zita soils are in cultivation.

Zita fine sandy loam, 0 to 1 percent slopes (ZfA).—This soil has a dark-brown fine sandy loam surface layer, 8 to 12 inches thick. The subsoil is calcareous and is lighter colored and more clayey than the surface layer.

This soil normally receives runoff from the surrounding, slightly higher lying soils. In many areas 2 to 6 inches of loamy fine sand is in the plow layer.

This soil produces good yields of cotton and grain sorghum. It is susceptible to moderate wind erosion. (Capability unit IIIe–1 (dryland); capability unit IIe–4 (irrigated); Mixed Land range site.)

Zita loam, 0 to 1 percent slopes (ZmA).—This soil has a dark grayish-brown loam surface layer, 8 to 20 inches thick. It occupies depressed areas in association with higher lying Portales soils. It is minor in extent, and the mapped areas rarely exceed 20 acres in size.

Yields of grain sorghum and cotton are good under either dryland or irrigated farming. Irrigated areas are well suited to alfalfa and to perennial grasses. This soil is slightly susceptible to wind erosion. (Capability unit IIIce–1 (dryland); capability unit IIe–3 (irrigated); Deep Hardland range site.)

Use and Management of the Soils

In this section wind erosion and the general management practices used on cropland are discussed. The system of capability groupings used by the Soil Conservation Service is explained, and the soils of Yoakum County are grouped into capability classes, subclasses, and units. Management by capability units for both dryland and irrigation farming is discussed. A yield table gives the estimated yields of each cultivated soil in the county under two levels of management. Range management and the range sites in the county are also discussed in this section.

Wind Erosion and Its Control

Wind erosion is the greatest hazard to cultivation in Yoakum County. Its control is one of the main problems of soil management.

Wind erosion is caused by high winds that blow loose, unprotected soil (fig. 9). Small soil particles, such as medium to fine sand, begin to roll or creep, or to move across the surface soil in a series of bounces. Where these particles strike unprotected soil, they loosen and free other particles. Some of the finer particles, such as silt and clay, are sometimes carried high into the air and may float for days before settling. The danger of soil blowing is greatest late in winter and early in spring. In these sea-

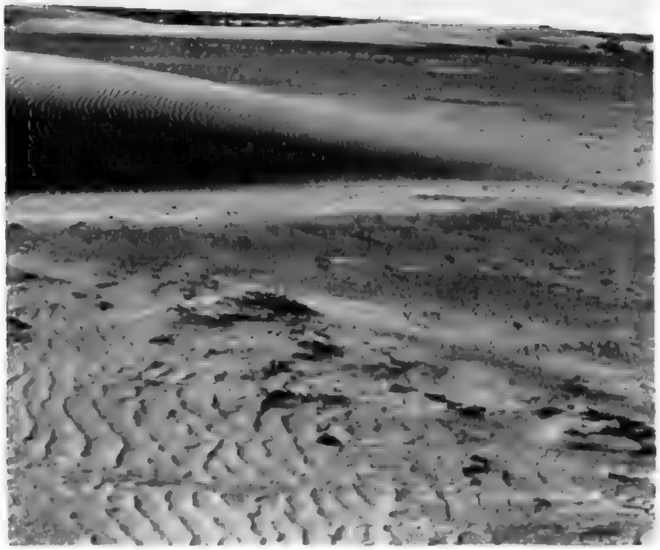

Figure 9.—**A Brownfield fine sand that has been severely eroded. Most of these eroded areas are abandoned.**

sons the wind usually blows the strongest, the land has the least vegetation, and the soil is most susceptible to blowing.

The soil is eroded by wind mainly because it lacks vegetation. Though drought is the obvious cause of the lack of vegetation, it is not the only cause. The way the land is used is a factor. Large acreages that were suited only to permanent grass have been cultivated. They have provided low returns and have left the land bare and subject to severe erosion. Erosion also results from the growing of cultivated crops that do not produce enough cover. Improper tillage implements have also depleted vegetation and thus caused erosion. The practice of shallow breaking increases the hazard. High temperatures and dry years have also been factors.

Management practices are needed that will best control wind erosion. It is much more practical to use permanent practices than to delay and then to use emergency ones. The following help to protect the soil from wind erosion: (1) soil cloddiness, (2) surface roughness, (3) the use of surface cover or crop residue, or the use of both.

Effects of wind erosion.—A description of soils in Yoakum County would not be complete unless the effects of wind erosion were fully recognized. Although "eroded" does not appear in names of soil mapping units, all of the cultivated soils and some of the soils used only for grazing have been altered by the wind. Because wind erosion is the major hazard to agriculture in this county, the soils must be managed to prevent rapid and lasting damage. On cultivated soils wind erosion may remove as much as half the original surface layer; or some of the organic matter, silt, and clay from the plow layer; or it may cause an accumulation of 4 to 6 inches of sandy material.

The hazard of wind erosion is least on noncalcareous loams and increases with the amount of sand or lime in the subsoil. The finer textured soils, such as loams, are least affected by wind erosion because tillage generally roughens and clods them so that they can resist blowing. Wind winnowing, however, has removed enough of the organic matter, silt, and clay from the surface soil in most areas to make it coarser textured and somewhat lighter colored than when first cultivated. Thus, soils become more susceptible to erosion and have less capacity to hold water and plant nutrients.

The fine sandy loams are moderately susceptible to wind erosion and have been greatly altered. In some small areas nearly all of the original surface layer has been removed by wind. The reduced fertility and poor moisture-holding capacity that result are reflected in the lower yields of crops in these areas. The most damaging effect of blowing probably has been the removal of organic matter, silt, and clay from the plow layer of these soils. The remaining sandy layer is practically sterile and is highly susceptible to wind erosion. To offset these effects, farmers have plowed deeper to bring more clayey material from below.

The coarse-textured loamy fine sands and fine sands show the most drastic effects of wind erosion. In cultivated areas of these soils, fence-row dunes up to 10 feet high are common. Farm buildings are often nearly surrounded by loose sand dunes. County roads may be closed by drifting sand during one hard blow. Farmers often have to plant their crops three or four times because of shifting sand in the early spring blows. In places abandoned fields have lost all of the thick, sandy surface layer. The blowing of sterile sand from these areas to adjoining areas of more productive soils is especially damaging.

Rangeland also shows the effects of wind erosion. Some of the soil is shifted or removed. Generally, however, the soil is blown onto the rangeland from cultivated areas. In some places several acres are covered with 6 inches to 3 feet of sand. In such areas the good grasses are smothered, and weeds and brush grow.

From one cultivated field in Yoakum County, the eroding soil moved 1½ miles in a northeasterly direction across rangeland and killed all the native grasses in its path. Only undesirable weeds and brush remained, and the value of the area as rangeland was reduced.

One of the least noticeable, yet most damaging effects of wind erosion, is the blowing of clay and silt from cultivated land to rangeland. These materials are carried many miles and deposited as a thin mantle on much of the rangeland. Though this mantle is only ⅛ to ¼ inch thick, it forms a very effective crust that reduces water intake. The crust increases runoff and water erosion and thus takes greatly needed moisture from the good grasses.

General Management of Cropland

The chief problems in use and management of the soils of Yoakum County are control of soil erosion, conservation of moisture, use of suitable cropping systems, use of tillage, and maintenance of fertility. Most of the soils in the county need protection from wind and water erosion.

Some of the management practices used on the soils of Yoakum County are next discussed. Generally, a combination of practices is needed. These practices are referred to in the section "Capability Groups of Soils."

Cropping systems

In planning a cropping system, the soil properties that need the most careful attention should be considered. This will insure the most efficient production over a period of years. The limitations of a soil will determine the types of crops and the frequency with which they can be grown.

The crops grown in a cropping system should (1) conserve the soil; (2) use available moisture efficiently; (3) protect the soil from wind and water erosion; (4) maintain or improve the physical condition, fertility, and biological condition of the soil; (5) help control weeds, insects, and disease; and (6) fit into a long-time plan of land use that is economically sound and feasible.

In Yoakum County the cropping system should include crops that provide maximum protection of the soil when the risk of wind erosion is greatest. Although cotton is the most common cash crop, it leaves little residue after harvest. Therefore, the soil is not adequately protected in critical periods of blowing.

In general, grasses, legumes, and other high-residue crops should be grown more often in the cropping system as the hazard of soil erosion and soil deterioration increases.

The use of crop residue

Crop residue or stubble left in the field after crops are harvested will protect the soil from damaging winds and maintain or improve its physical, chemical, and biological condition. This residue or stubble should be handled so as to leave a protective cover on the surface of the soil during the critical periods of soil blowing in winter and spring.

Vegetation and crop residues protect the soil as well as a roughened surface. Generally they have a greater capacity to trap the moving soil than a rough or cloddy surface. In addition to providing roughness, the cover helps to reduce wind erosion. Tall stubble reduces the surface velocity of the wind more effectively than an equal weight of short stubble. Residue from grain sorghum or crops of small grain and winter peas and vetch make good cover for soil protection. Grass makes one of the best covers because it has a relatively large protective surface above and below the ground and is well anchored.

Grain-sorghum stalks are generally used to protect the soil, either in closely spaced or in 40-inch rows. The height of the stubble is 10 to 14 inches. The rest of the stalk, which has been through a combine, is left on the ground.

Stubble mulching

Stubble mulching is a practice in which all the tilling, planting, cultivating, and harvesting are designed to keep enough vegetation on the surface until the next crop is seeded (fig. 10). It requires special equipment. Where stubble mulching is practiced, the crop residue is actually managed the year around.

Stubble mulching is an excellent practice on all soil types. It will (1) control wind and water erosion; (2) improve the physical, chemical, and biological condition of the soil; (3) save moisture and reduce surface evaporation; and (4) reduce the rate at which organic matter decreases.

Figure 10.—**Grain-sorghum stubble on or near the surface.**

Contour farming and terraces

In contour farming, the plowing, planting, and other cultivation practices are done along the contour. The contour lines that are followed may be on established terraces, in contour strips, or along natural contour lines.

Terraces are used to hold runoff and distribute it in such a way that most of it is available to plants (fig. 11). In Yoakum County much of the rain comes rapidly; sometimes 1 to 2 inches fall in an hour. By using contour farming and terraces, farmers store much moisture in the subsoil for future crops.

Tillage

The purposes of tillage are to prepare the seedbed, to control weeds, and to manage crop residue. All tillage operations should help produce and maintain good tilth, or physical condition, of the surface soil. In Yoakum County, tillage is the principal means by which a farmer carries out his soil management program.

Deep plowing.—This practice helps to make the soil less susceptible to blowing. It is now a widely accepted practice in Yoakum County on fine sands and loamy fine sands.

Deep plowing brings 4 to 6 inches of the sandy clay loam subsoil to the surface in the furrow slice (fig. 12). When this finer material is mixed with the sandy surface soil, the texture of the plow layer becomes less sandy. The soil then may be roughened to form stable clods that will not blow easily. Crops that leave enough residue on the surface to control wind erosion are almost impossible to grow on dryland farmed areas of sandy erodible soils. Following deep plowing, however, crop residue, cloddiness, and roughness can be successfully combined to control wind erosion. If used alone, deep plowing is not enough.

The real significance of the plowing is the bringing up of the clayey soil material from below to increase soil

Figure 11.—**Top: Terraces are used to effectively control water erosion. Bottom: The effects of gully erosion on a field not protected by terraces.**

productivity. The more clayey soil will, no doubt, maintain a cloddier and less erodible structure as long as no soil drifting occurs. But if stability of the surface is not maintained after deep plowing, beneficial results from the practice are short lived. Continued drifting of the surface will eventually bring about a condition where clayey material is not within the reach of further deep plowing. The resulting deep mantle of sand will then tend to be more hazardous than the initial shallower mantle (*4*)[1].

Soil cloddiness.—This is a form of surface roughness. The clods reduce susceptibility to wind erosion, because the clods at the surface are too large to be moved by wind. Clods that will resist wind erosion are about the size of an alfalfa seed, 0.84 millimeter ($\frac{1}{32}$ of an inch) in diameter. The degree of protection depends on the size, stability, and amount of clods.

The formation of clods is related to the texture of the soil. The most clods will form on surfaces that contain 20 to 35 percent clay. The clay binds the particles of sand and silt together to form clods. The stability of the clods varies directly with the percentage of clay in the soil. The lime in the soil also reduces their stability.

Larger clods are not so effective as smaller ones that have more protective surface in proportion to their weight. Often the only suitable practice is the use of a tillage implement that will bring as many clods to the surface as possible, even if the clods are not an ideal size.

A rough surface is more resistant to wind erosion than a smooth one. It slows down wind velocity at the surface and traps the particles that have been removed from the more exposed areas. The surface soil may be roughened by listing.

Use of commercial fertilizers

The use of commercial fertilizers is increasing each year. On dry-farmed areas, moisture is the limiting factor on most soils. Farmers have noticed, however, that yields have declined on areas that have been irrigated for 3 or 4 years. At present, fertilizer is applied to all cotton on irrigated areas and to much of the cotton on dry-farmed areas.

A farmer should use amounts of fertilizer that are based on needs determined by soil tests. The soil maps at the back of the report will help in selecting sites on which to take soil samples.

Stripcropping

This is a protective practice that consists of growing crops in alternate bands or strips. In one band are tall, leafy crops that leave much residue and serve as a protective barrier against erosion. In the next band is a row crop, or fallow land. Crops suitable for the protective bands are grain and forage sorghum, sudan, and tall perennial grasses. The protective bands protect the companion crop from the sand-blasting wind and protect the soil after the companion crop is harvested.

A common practice in Yoakum County is to plant 4-row bands of grain sorghum and alternate 8-row bands of cotton. Highly erodible soils used for cotton should be

Figure 12.—**Deep plowing on Brownfield fine sand to a depth of 24 inches.**

[1] Italic numbers in parentheses refer to Literature Cited, p. 52.

listed soon after harvest. This practice prevents local soil blowing and the accumulation of soil in the bands of protective crops.

Irrigation

Available irrigation water does not occur in a definite pattern in Yoakum County. It occurs throughout the county in spots, however, except in the extreme northeastern part. In this area there are not enough water-bearing sands to indicate that irrigation wells would be feasible.

In most areas the wells range in depth from 80 to 180 feet. They produce at rates ranging from 200 to 800 gallons per minute. Sprinkler-type systems are used most extensively (fig. 13). A few flood-type systems are used in the nearly flat areas and on the more clayey soils, however.

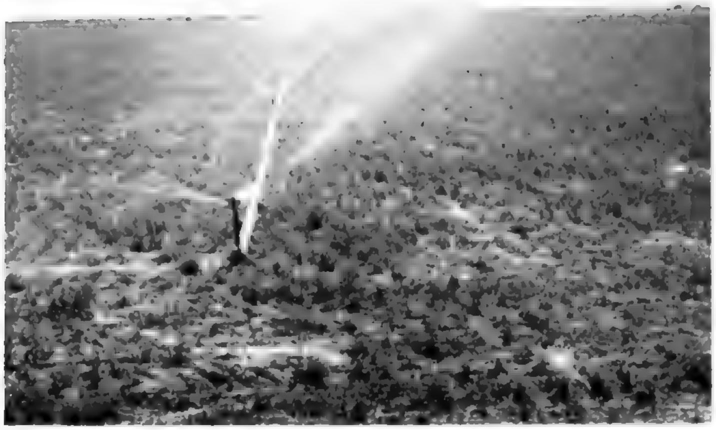

Figure 13.—**A sprinkler irrigation system in operation.**

The factors to be considered in designing an irrigation system are: (1) the quality and quantity of available water; (2) the rate the soil will take water and the amount it will hold; (3) the water needs of the crop to be grown; and (4) the topography of the land.

Unless the soil is managed well, the best system for control and distribution of irrigation water will not be successful.

The use of a conservation irrigation system prolongs the supply of available water and produces crops more economically. The use of a well-designed system allows the farmer to—

1. Supplement rainfall by supplying additional moisture to the crop.
2. Maintain or improve productivity. (This is the most important benefit.)
3. Hold soil erosion to a minimum.
4. Prevent excessive leaching of plant nutrients.
5. Dispose of excess water safely.
6. Prevent waterlogging or the accumulation of harmful salts.
7. Produce crops in which the plants grow at the same rate to maturity without damage from lack of water.
8. Produce maximum yields of crops under the existing conditions.
9. Maintain proper moisture at all times.

Engineers in the Soil Conservation Service will assist in designing a conservation irrigation system that is suited to the soil, the water supply, and the selected crops.

Capability Groups of Soils

The capability classification is a grouping that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products. There are no class I, class V, or class VIII soils in Yoakum County.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no susceptibility to erosion but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIIe-1 or IIIe-2.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

Management by capability units (dryland)

The dominant limitations on agriculture in Yoakum County are low annual rainfall and high wind velocities

in spring. Dryland management of the soils requires practices that will maintain the supply of organic matter, prevent soil structure from deteriorating, control wind and water erosion, and conserve the limited moisture.

The soils of Yoakum County have been placed in the following capability classes, subclasses, and units for dryland farming. Use and management for each capability unit are discussed. The soils in one capability unit need similar management and respond to that management in about the same way.

In the extreme southwestern part of the county, there is a transitional zone to an area of less rainfall. All of the soils in this part of the county are used either for range or for irrigated crops. If these soils were used for dryland farming, however, the yields would be lower than elsewhere in the county. Generally, soils that are in class III in the northern and eastern parts of the county are in class IV in the southern and western parts. Soils in class IV in northern and eastern parts are in class VI in the southern and western parts. Very little cultivation has been done in the southern and western parts of the county. Farmers should consult the local agricultural workers before they attempt to cultivate any land in the southern and western parts of the county without irrigation.

Class I.—Soils that have a few limitations that restrict their use. (No class I soils in the county.)

Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices. (No class II soils in the county.)

Class III.—Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

- Subclass IIIe.—Soils subject to severe erosion if they are cultivated and not protected.
  - Capability unit IIIe-1.—Reddish-brown to dark grayish-brown fine sandy loams that are moderately permeable and have a moderate capacity for holding water and plant nutrients.
  - Capability unit IIIe-2.—Brown to grayish-brown, calcareous fine sandy loams that are moderately rapidly permeable and are nearly level to gently sloping.
- Subclass IIIce.—Soils subject to moderate wind erosion, if they are cultivated, and that have a severe climatic limitation.
  - Capability unit IIIce-1.—Nearly level, brown to dark-brown loams that are slowly to moderately permeable and have a moderate capacity for holding water and plant nutrients.
  - Capability unit IIIce-2.—Nearly level, brown to dark grayish-brown, calcareous loams that are moderately permeable and have a high capacity for holding water and plant nutrients.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

- Subclass IVe.—Soils subject to very severe erosion if they are cultivated and not protected.
  - Capability unit IVe-1.—Deep, reddish-brown to grayish-brown, moderately permeable to moderately rapidly permeable soils that have a sandy surface layer.
  - Capability unit IVe-2.—Soils that have a sandy surface layer, are moderately to moderately rapidly permeable, moderately deep to deep, and are nearly level to gently sloping or undulating.
  - Capability unit IVe-3.—Shallow, reddish-brown to grayish-brown fine sandy loams that are nearly level to gently sloping.
  - Capability unit IVe 4.—Shallow, grayish-brown to brown loams that are nearly level to gently sloping.
- Subclass IVes.—Strongly calcareous soils that are suitable for native grasses and have very severe limitations if tilled.
  - Capability unit IVes-1.—Grayish-brown fine sandy loams and loams that have a very low capacity to hold water and plant nutrients; have a very high content of lime that results in clods that are easily broken; and are very highly susceptible to wind erosion.

Class V.—Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, woodland, or wildlife food and cover. (No class V soils in the county.)

Class VI.—Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range, woodland, or wildlife food and cover.

- Subclass VIe.—Soils severely limited, chiefly by risk of erosion if protective cover is not maintained.
  - Capability unit VIe-1.—Yellowish-red to grayish fine sands that have a surface layer more than 18 inches thick; moderately to moderately rapidly permeable.
  - Capability unit VIe-2.—Shallow sandy soils that are not suitable for cultivation.
  - Capability unit VIe-3.—Deep, grayish-brown sandy soils that are nearly level and moderately rapidly permeable.
- Subclass VIw.—Soils severely limited by excess water and generally unsuitable for cultivation.
  - Capability unit VIw-1.—Dark-colored, poorly drained soils in playa beds.
- Subclass VIs.—Soils generally unsuitable for cultivation and limited for other uses by their moisture capacity, stones, or other features.
  - Capability unit VIs-1.—Very shallow, gently sloping to steeply sloping soils that are unsuited to cultivation.

Class VII.—Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation, and that restrict their use largely to grazing, woodland, or wildlife.

- Subclass VIIe.—Soils very severely limited, chiefly by risk of erosion if protective cover is not maintained.
  - Capability unit VIIe-1.—Deep, light-colored extremely sandy soils.
  - Capability unit VIIe 2.—Shallow to deep sandy soils that are strongly sloping and unsuited to cultivation.

Subclass VIIs.—Soils very severely limited by moisture capacity, stones, or other soil features.

Capability unit VIIs-1.—Very shallow to shallow, stony soils.

Class VIII.—Soils and landforms that have limitations that preclude their use, without major reclamation, for commercial production of plants; and restrict their use to recreation, wildlife, water supply, or esthetic purposes. (No class VIII soils in the county.)

CAPABILITY UNIT IIIe-1 (DRYLAND)

This unit consists of deep and moderately deep, reddish-brown to dark grayish-brown, moderately permeable fine sandy loams that are nearly level to gently sloping. The soils in this unit are—

Amarillo fine sandy loam, 0 to 1 percent slopes.
Amarillo fine sandy loam, 1 to 3 percent slopes.
Arvana fine sandy loam, 0 to 1 percent slopes.
Arvana fine sandy loam, 1 to 3 percent slopes.
Spur and Bippus soils.
Zita fine sandy loam, 0 to 1 percent slopes.

These soils are susceptible to moderate wind erosion and slight to moderate water erosion. They have a moderate capacity for holding water and plant nutrients. The Spur and Bippus soils absorb water at a slightly higher rate than the other soils in this unit. Practices are necessary to control wind erosion, conserve moisture, and maintain crop production.

Cotton and grain sorghum are the main cash crops. Small grain may also be grown for a cash crop.

The cropping system should include high-residue crops on two-thirds of the land each year. Also satisfactory is a cropping system in which a high-residue crop such as grain sorghum is grown each year in strips that make up half the land. A crop such as cotton may be grown on the other strips. Each strip used for cotton would be planted the next year to a high-residue crop. Residue should be left on the surface to help reduce erosion in seasons when blowing is critical. In years when adequate residue is not produced, rough tillage should be used to help control erosion.

CAPABILITY UNIT IIIe-2 (DRYLAND)

This unit consists of deep, brown to grayish-brown, moderately rapidly permeable, calcareous fine sandy loams that are nearly level to gently sloping. The soils in this unit are—

Portales fine sandy loam, 0 to 1 percent slopes.
Portales fine sandy loam, 1 to 3 percent slopes.

These soils are susceptible to moderate wind erosion and slight to moderate water erosion. They have a moderate capacity to hold water and plant nutrients.

Cotton and grain sorghum are the main cash crops. Small grain may also be grown for a cash crop.

The cropping system should include high-residue crops on two-thirds of the land each year. Also satisfactory is a cropping system in which a high-residue crop such as grain sorghum is grown each year in strips that make up half the land. A crop such as cotton may be grown on the other strips. Each strip used for cotton would be planted the next year to a high-residue crop. All crop residues should be left on the surface to help reduce wind erosion in seasons when blowing is critical. In years when adequate residue is not produced, listing or chiseling, or other rough tillage helps to control wind erosion.

CAPABILITY UNIT IIIce-1 (DRYLAND)

This unit consists of nearly level, moderately deep, brown to dark-brown soils that are noncalcareous and are slowly to moderately permeable. The soils in this unit are—

Stegall loam, 0 to 1 percent slopes.
Zita loam, 0 to 1 percent slopes.

These soils are slightly to moderately susceptible to wind erosion. They have a moderate capacity for holding water and plant nutrients. Lack of moisture limits production on these soils.

The main cash crops are cotton and grain sorghum. The cropping system should include a high-residue crop on half of the land each year. Crops such as grain sorghum and small grain produce relatively large amounts of residue that help to maintain the content of organic matter. If kept on the surface, the residue will help to reduce erosion by providing a cover during periods when the hazard of wind erosion is high. When rainfall is low, or after such periods, if there is not enough residue to control soil blowing, the soils should be chiseled or listed. This practice helps to keep them cloddy and rough.

CAPABILITY UNIT IIIce-2 (DRYLAND)

This unit consists of a deep, moderately permeable, brown to dark grayish-brown soil. The surface layer is calcareous loam. There is a zone of calcium carbonate accumulation 24 to 36 inches below the surface. This is a nearly level soil that has slopes of 1 percent or less. The soil is—

Portales loam, 0 to 1 percent slopes.

This soil has a moderate susceptibility to wind erosion. It has, however, a high capacity to hold water and plant nutrients.

Cotton is the main cash crop. Other cash crops are grain sorghum and some small grain.

The cropping system should provide a high-residue crop on three-fifths of the land each year. Residue kept on the surface in seasons when soil blowing is critical helps to control wind erosion.

During or following dry years, when little crop residue is produced, this soil should be chiseled, listed, or otherwise tilled so that the surface is left cloddy or rough.

CAPABILITY UNIT IVe-1 (DRYLAND)

In this unit are deep, reddish-brown to grayish-brown, moderately permeable to moderately rapidly permeable loamy fine sands that are nearly level to gently sloping. The soils in this unit are—

Amarillo loamy fine sand, 0 to 3 percent slopes.
Amarillo loamy fine sand, thin solum, 0 to 3 percent slopes.
Gomez loamy fine sand.

Because of their sandy surface soil and the dry climate, these soils are highly susceptible to wind erosion. They are slightly susceptible to water erosion on the steeper slopes. They have a high water-intake rate.

Soils that are protected from wind erosion may be used for cultivated crops, but they are best suited to perennial vegetation. Cotton and grain sorghum are the main cash crops. Where cotton is grown, the soil is left without cover much of the time.

On the soils that can be deep plowed successfully, the cropping system should include a high-residue crop such

as grain sorghum on three-fourths of the land each year. Also satisfactory is a cropping system in which a high-residue crop such as grain sorghum is grown each year in strips that make up two-thirds of the land. A crop such as cotton may be grown on the other strips. Each strip used for cotton would be planted the next year to a high-residue crop.

On soils that cannot be deep plowed successfully, a high-residue crop such as grain sorghum or small grain, should be grown each year. The crop residue should be kept on the surface for control of wind erosion. In years when there is not enough crop residue to control wind erosion, chiseling, listing, or other rough tillage should be used.

CAPABILITY UNIT IVe-2 (DRYLAND)

The soils in this unit are yellowish-red, moderately to moderately rapidly permeable sandy soils that are nearly level to gently sloping or undulating. The soils in this unit are—

Brownfield fine sand, thin surface.
Springer and Brownfield soils, moderately shallow.

These soils are highly susceptible to wind erosion. The sandy surface layer has a low capacity to hold water and plant nutrients. Wind erosion is difficult to control on these soils.

Grain sorghum is the main cash crop, but some cotton is grown. Cotton stubble provides little protection. Consequently, the soil in fields that have been planted to cotton, particularly in dry-farmed areas, is generally the first to start blowing in spring.

These soils are best suited to perennial grasses. When moisture is adequate, plant growth is often limited by the low fertility.

On soils that are deep plowed, the cropping system should include a high-residue crop such as grain sorghum on three-fourths of the land each year. On soils that are not deep plowed, a high-residue crop such as grain sorghum should be grown each year. The residue from these crops should be kept on the surface to help control wind erosion. In years when there is not enough residue to control wind erosion, chiseling, listing, or other rough tillage helps to reduce erosion.

CAPABILITY UNIT IVe-3 (DRYLAND)

This unit consists of shallow, moderately permeable, reddish-brown to grayish-brown fine sandy loams. These soils are nearly level to gently sloping. The Arvana soils are underlain by hard caliche at a depth of 12 to 20 inches. The Mansker soils are limy to the surface. The soils in this unit are—

Arvana fine sandy loam, shallow, 0 to 1 percent slopes.
Mansker fine sandy loam, 0 to 1 percent slopes.
Mansker fine sandy loam, 1 to 3 percent slopes.

These soils are moderately susceptible to wind erosion. The Mansker soil with a slope of 1 to 3 percent is moderately susceptible to water erosion. All of the soils have moderate capacity to hold water and plant nutrients. Because of slight depth, these soils are often droughty. Often too little residue is produced to control wind erosion.

These soils are best suited to permanent vegetation. Grain sorghum is the main cash crop.

The cropping system should include a high-residue crop on three-fourths of the land each year. Also satisfactory is a cropping system in which a high-residue crop is grown each year in strips that make up two-thirds of the land. A crop such as cotton may be grown on the other strips. Each strip used for cotton would be planted the next year to a high-residue crop. The residue should be kept on the surface to control wind erosion. In years when residue is not adequate, tillage such as chiseling should be used to help control erosion.

CAPABILITY UNIT IVe-4 (DRYLAND)

This unit consists of shallow, grayish-brown to brown loams that are slowly to moderately permeable. The soils in this unit are—

Lea loam, shallow, 0 to 1 percent slopes.
Mansker loam, 0 to 1 percent slopes.
Stegall loam, shallow, 0 to 1 percent slopes.

Because of the dry climate and the shallowness of these soils, yields are limited. The hazard of wind erosion is moderate. These soils are often droughty, and often too little residue is produced to control wind erosion.

These soils are best suited to permanent vegetation. Grain sorghum is the main cash crop.

High-residue crops such as grain sorghum or small grain should be grown on three-fourths of the land each year. Also satisfactory is a cropping system in which a high-residue crop such as grain sorghum is grown each year in strips that make up two-thirds of the land. A crop such as cotton may be grown on the other strips. Each strip used for cotton would be planted the next year to a high-residue crop.

The residue should be kept on the surface to help control wind erosion. High-residue crops that improve the soil may be used in the cropping system. In years when adequate residue is not produced, chiseling or other rough tillage should be used to help control erosion.

CAPABILITY UNIT IVes-1 (DRYLAND)

This unit consists of grayish-colored, shallow, level to gently sloping, calcareous fine sandy loams and loams. These soils have a moderately permeable subsoil. The soils in this unit are—

Arch loam, thin surface.
Arch complex.
Drake soils, 1 to 3 percent slopes.

These soils are all highly susceptible to wind erosion; the Drake soils are moderately susceptible to water erosion. The soils have a very low water-storage capacity. The large amount of free lime in these soils slows the release of plant nutrients and frequently causes the leaves of grain sorghum to turn yellow.

The soils in this unit are best suited to permanent vegetation. However, an effective cropping system is one in which a high-residue crop such as grain sorghum is grown each year in strips that occupy three-fourths of the land. A crop such as cotton may be grown on the other strips. Each strip used for cotton would be planted the next year to a high-residue crop. An alternative cropping system is that of growing grain sorghum, a small grain, or a similar high-residue crop each year. The crop residue should be kept on the surface to give the best protection from wind erosion. In years when residue is not produced, chiseling, listing, or similar tillage is needed in places to help control wind erosion.

CAPABILITY UNIT VIe-1 (DRYLAND)

This unit consists of deep fine sands that are nearly level to steep. The soils in this unit are—

Brownfield fine sand, thick surface.
Brownfield soils, severely eroded.

These soils are very susceptible to wind erosion. Their capacity to hold water and plant nutrients is low. Because of the thick sandy surface soil, deep plowing to increase the clay content in the surface soil is not practical. Also, it is not practical to cultivate these soils for dryland farming. These soils are best suited to tall, perennial grasses. More information on the use and management of these soils for range is in the section "Range Management."

CAPABILITY UNIT VIe-2 (DRYLAND)

The soils in this unit are shallow, reddish-brown loamy fine sands that are nearly level to gently sloping. Hard rock is 10 to 20 inches below the surface. The soils are—

Springer and Brownfield soils, shallow.

These soils are highly susceptible to wind erosion and are not suited to cultivation. If used for range, careful management is needed to control erosion. More information on their use and management is in the section "Range Management."

CAPABILITY UNIT VIe-3 (DRYLAND)

The soil in this unit consists of grayish-brown fine sand that is nearly level and moderately rapidly permeable. It has a calcareous subsoil. The soil in this unit is—

Gomez fine sand.

This soil is highly susceptible to wind erosion. Its capacity to hold water and plant nutrients is low. It is not practical to cultivate the soil for dryland farming. This soil is best suited to tall, perennial grasses.

CAPABILITY UNIT VIw-1 (DRYLAND)

The soil in this unit is a gray to dark-gray, weakly developed, poorly drained soil in the playas. This soil is—

Randall clay.

This soil is frequently flooded by runoff from soils at higher elevations. Consequently, the hazard of flooding limits its use. In long, dry spells, many of the small, shallow lakes dry out and are farmed. Areas of this soil are not suited to drainage.

If the surrounding areas are in crops, this soil can also be cropped in dry years. In wet years it produces annual weeds and grasses. Areas of this soil in range will provide a temporary supply of water for livestock.

More information on the use and management of this soil for range is in the section "Range Management."

CAPABILITY UNIT VIs-1 (DRYLAND)

This unit consists of a complex of soils. These soils are dark grayish-brown, gently sloping to strongly sloping, and very shallow to moderately deep. They occur on the slopes of draws. These soils are moderately permeable. In this unit is—

Berthoud-Potter complex.

These soils are moderately susceptible to wind and water erosion. They are too shallow or too steep to be cultivated. If used for range, they need careful management that will control erosion. Areas where grasses have been killed by overgrazing should be reseeded to blue grama and side-oats grama. Newly seeded areas need to be protected from grazing for at least one season. This practice allows the plants to become well established.

More information on the use and management of these soils for range is given in the section "Range Management."

CAPABILITY UNIT VIIe-1 (DRYLAND)

This unit consists of a complex of soils. These soils are deep, loose fine sands. They are moderately to rapidly permeable. In this unit is—

Brownfield-Tivoli fine sands.

These soils are highly susceptible to wind erosion and are not suited to cultivation. Because there is no runoff, much water is available for the plants and tall, native grasses that grow on these soils. The capacity of these soils to hold water and plant nutrients is low. Deep breaking to bring clay to the surface is not practical because the clay is 36 to 60 inches below the surface. The billowy surface makes normal farming operations extremely difficult.

Cultivated areas should be reseeded to tall, native grasses. Careful protection of these soils from fire and overgrazing helps to control wind erosion.

More information on the use and management of these soils for range is in the section "Range Management."

CAPABILITY UNIT VIIe-2 (DRYLAND)

This unit consists of a complex of soils. These soils are steep, shallow to deep, rapidly permeable fine sands that vary in depth over hard rock. In this unit is—

Tivoli-Potter complex.

These soils are highly susceptible to wind and water erosion. They are not suited to cultivation. If they are used for range, careful management is needed to control erosion.

Cultivated areas should be reseeded to native grasses. Overgrazed pastures should be rested until grasses have recovered enough to help control wind erosion. New grass seedings should not be grazed for 1 to 2 years so that they can become well established.

More information on the use and management of this complex for range is in the section "Range Management."

CAPABILITY UNIT VIIs-1 (DRYLAND)

This unit consists of dark grayish-brown, nearly level to gently sloping, very shallow to shallow soils. These soils are slowly to moderately permeable. The soils in this unit are—

Kimbrough soils.
Kimbrough-Stegall complex.

Because of their slight depth, these soils are not suited to cultivation. They support little native vegetation. Even when they are used for range, careful management is needed to control erosion.

Overgrazed pastures should be rested 2 to 3 years to allow recovery of the native grasses. Grazing should be managed so that at least half of the current year's growth is left on the ground. This practice helps to control erosion and also helps to form a mulch that allows more water to enter the soil.

Information on the use and management of these soils for range is in the section "Range Management."

Management by capability units (irrigated)

The soils of Yoakum County suitable for irrigation have been placed in the following capability classes, subclasses, and units. The use and management for each capability unit are discussed.

Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIe.—Soils subject to moderate erosion if they are not protected.

Capability unit IIe–1.—Nearly level, slowly permeable, noncalcareous, brown to dark-brown loams that have a moderate capacity for holding water and plant nutrients.

Capability unit IIe–2.—Deep, nearly level, brown to grayish-brown loams that are calcareous and moderately permeable.

Capability unit IIe–3.—Moderately deep, nearly level, moderately permeable, brown to dark grayish-brown soils that have a surface layer of noncalcareous loam.

Capability unit IIe–4.—Deep and moderately deep, nearly level, reddish-brown to dark grayish-brown fine sandy loams that are moderately permeable and have a moderate capacity for holding water and plant nutrients.

Capability unit IIe–5.—Moderately deep, nearly level, dark grayish-brown fine sandy loams that are calcareous and moderately rapidly permeable.

Class III.—Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Subclass IIIe.—Soils subject to severe erosion if they are cultivated and not protected.

Capability unit IIIe–1.—Deep and moderately deep, reddish-brown to grayish-brown, moderately to moderately rapidly permeable sandy soils.

Capability unit IIIe–2.—Reddish-brown to dark grayish-brown, moderately to moderately rapidly permeable fine sandy loams that are gently sloping.

Capability unit IIIe–3.—Dark grayish-brown, calcareous fine sandy loams that are moderately rapidly permeable and are gently sloping.

Capability unit IIIe–4.—Shallow, reddish-brown to grayish-brown, moderately permeable soils that have a loam to fine sandy loam surface layer.

Capability unit IIIe–5.—Yellowish-red, moderately to moderately rapidly permeable sandy soils that are nearly level to gently sloping.

Subclass IIIes.—Strongly calcareous soils that have severe limitations if cultivated.

Capability unit IIIes–1.—Loams that have a very low capacity to hold water and plant nutrients and are moderately susceptible to wind erosion.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe.—Soils subject to very severe erosion if they are cultivated and not protected.

Capability unit IVe–1.—Light-colored, deep and moderately deep fine sands that have a low capacity for holding water and plant nutrients.

CAPABILITY UNIT IIe–1 (IRRIGATED)

In this unit is a moderately deep, brown to dark-brown, noncalcareous loam. It is nearly level, is slowly permeable, and is underlain by hard rock at a depth of about 30 inches. The soil in this unit is—

Stegall loam, 0 to 1 percent slopes.

This soil is slightly to moderately susceptible to wind erosion and is slightly susceptible to water erosion. The capacity to hold water and plant nutrients is moderate.

The main cash crops are cotton and grain sorghum. Other suitable crops are alfalfa, vetch, Austrian winter peas, small grain, and cowpeas. These crops serve as winter cover. If properly inoculated and irrigated, alfalfa will fix nitrogen from the atmosphere.

This soil is productive if irrigated. A high-residue crop should be grown on one-third of the land each year. A soil-improving crop, as a deep-rooted legume, should also be grown 1 year in 3. Deep-rooted legumes help to maintain or improve soil tilth. Emergency tillage such as chiseling should be used where there is not enough cover to control wind erosion. Tillage may also help to increase the initial intake of water and to store moisture temporarily. In places commercial fertilizer is needed to maintain good crop yields.

This soil may be irrigated by the level-border, level-furrow, graded-furrow, or sprinkler systems.

CAPABILITY UNIT IIe–2 (IRRIGATED)

In this unit is a nearly level, deep, moderately permeable, brown to grayish-brown soil. The surface layer is calcareous loam. A zone of calcium carbonate accumulation lies 24 to 36 inches below the surface. The soil in this unit is—

Portales loam, 0 to 1 percent slopes.

This soil is moderately susceptible to wind erosion but has a high capacity for holding water and plant nutrients.

Cotton is the main cash crop. Among other cash crops grown are grain sorghum and some small grain. Occasionally, grain sorghum shows symptoms of chlorosis, or yellowing of the leaves, caused by a deficiency of iron. Alfalfa, Austrian winter peas, cowpeas, and vetch may be included in a cropping system.

High-residue crops and soil-improving crops should be grown on two-fifths of the land each year. Vetch, winter peas, fertilized grain sorghum, or small grain may be used as high-residue and soil-improving crops. The crop residue should be managed on the surface to help control wind erosion. In places tillage such as chiseling is also needed when the residue is not adequate for control of erosion. Chiseling may also help to increase the initial intake of water. Commercial fertilizer is used to maintain high crop yields.

This soil may be irrigated by sprinkler, level-border, or level-furrow systems.

CAPABILITY UNIT IIe-3 (IRRIGATED)

In this unit is a nearly level, moderately deep, moderately permeable, brown to dark grayish-brown soil. The surface layer is noncalcareous loam. A zone of calcium carbonate accumulation is at a depth of 24 to 36 inches. The soil in this unit is—

Zita loam, 0 to 1 percent slopes.

This soil is slightly to moderately susceptible to wind erosion. The capacity to hold water and plant nutrients is high.

Cotton is the main cash crop. Others are grain sorghum and some small grain.

The cropping system should include a high-residue crop on one-third of the land each year. A soil-improving crop such as alfalfa, vetch, or Austrian winter peas should be grown on one-third of the land each year. For most effective control of wind erosion, crop residue should be managed on the soil surface in periods when soil blowing is critical. Tillage such as chiseling may be needed when there is not enough residue. In places chiseling may also help increase the initial intake of water. Commercial fertilizer will help maintain high crop yields.

This soil may be irrigated by sprinkler, level-border, or level-furrow systems.

CAPABILITY UNIT IIe-4 (IRRIGATED)

The soils in this unit are deep and moderately deep, noncalcareous, reddish-brown to dark grayish-brown fine sandy loams. These soils are nearly level. They are moderately permeable. The soils in this unit are—

Amarillo fine sandy loam, 0 to 1 percent slopes.
Arvana fine sandy loam, 0 to 1 percent slopes.
Spur and Bippus soils.
Zita fine sandy loam, 0 to 1 percent slopes.

These soils are susceptible to moderate wind erosion and slight water erosion. They have a moderate capacity to hold water and plant nutrients.

Cotton and grain sorghum are the main cash crops. Small grain and alfalfa may also be grown as cash crops.

These soils are very productive under irrigation. The cropping system should provide a soil-improving crop and a high-residue crop on one-third of the land each year. These crops may be vetch, winter peas, fertilized grain sorghum, or small grain. Crop residue should be managed on the surface in seasons of critical soil blowing to help control erosion. If residue is not adequate, tillage such as chiseling may also be needed. Tillage may be beneficial for increasing the initial intake of water and for storing water temporarily.

Commercial fertilizer may be applied to maintain or increase crop yields. Grasses and alfalfa, or other deep-rooted legumes will help to improve or maintain tilth.

These soils are suited to level-border, level-furrow, graded-furrow, or sprinkler irrigation.

CAPABILITY UNIT IIe-5 (IRRIGATED)

In this unit is a moderately deep, dark grayish-brown, calcareous fine sandy loam. This soil is nearly level and moderately rapidly permeable. The soil in this unit is—

Portales fine sandy loam, 0 to 1 percent slopes.

This soil is susceptible to moderate wind erosion and to slight water erosion. It has a moderate capacity to hold water and plant nutrients.

Cotton and grain sorghum are the main cash crops; small grain and alfalfa may also be grown. Occasionally grain sorghum shows symptoms of chlorosis, or yellowing of the leaves, caused by a deficiency of iron.

High-residue crops should be grown on half the land each year. A soil-improving crop should be grown on one-third of the land each year. Alfalfa, vetch, Austrian winter peas, cowpeas, or other soil-improving crops help to improve tilth and fertility. Crop residue should be managed on the surface to help control wind erosion. If crop residue is not adequate to control wind erosion, emergency tillage may be used to roughen the surface.

Commercial fertilizer can be used to maintain high crop yields. This soil can be irrigated by the level-furrow, level-border, or sprinkler systems.

CAPABILITY UNIT IIIe-1 (IRRIGATED)

The soils in this unit are deep and moderately deep, reddish-brown to grayish-brown, moderately to moderately rapidly permeable loamy fine sands. They are nearly level to gently sloping. The soils in this unit are—

Amarillo loamy fine sand, 0 to 3 percent slopes.
Amarillo loamy fine sand, thin solum, 0 to 3 percent slopes.
Gomez loamy fine sand.

These soils are highly susceptible to wind erosion and are moderately susceptible to water erosion. The sandy surface soil has a low capacity for holding water and plant nutrients. Plant growth is more affected by low fertility on irrigated areas of these soils than on irrigated areas of less sandy soils.

Areas protected from wind erosion may be used for cultivated crops but are best suited to perennial vegetation. Cotton and grain sorghum are the main cash crops. Areas planted to cotton are left without cover much of the time. In irrigated areas alfalfa and small grain are successfully grown. Vetch, Austrian winter peas, and cowpeas may also be included in the cropping system.

In areas that have been successfully deep plowed, the cropping system should include a high-residue crop and a soil-improving crop on half of the land each year. On soils that have not been deep plowed, the cropping system should include high-residue crops 2 years in 3. Soil-improving crops should be grown 1 year in 2. The crop residue should be kept on the surface to help control wind erosion.

Deep plowing is effective in controlling wind erosion. Fertilizer will help to improve crop yields. Only sprinkler irrigation systems are successful.

CAPABILITY UNIT IIIe-2 (IRRIGATED)

This unit consists of gently sloping, reddish-brown to dark grayish-brown fine sandy loams. These soils are deep and moderately deep and are moderately to moderately rapidly permeable. The soils in this unit are—

Amarillo fine sandy loam, 1 to 3 percent slopes.
Arvana fine sandy loam, 1 to 3 percent slopes.

Cultivated areas are susceptible to moderate wind and water erosion. The capacity of these soils to hold water and plant nutrients is moderate.

Cotton is the main cash crop. Other cash crops are grain sorghum and small grain, which supply residue that helps control wind erosion. Alfalfa, vetch, Austrian winter peas, and cowpeas are successfully included in cropping systems.

The cropping system should include a high-residue crop and a soil-improving crop on half of the land each year. The crop residue should be managed on the surface to help control erosion in periods when soil blowing is critical. If there is not enough residue, tillage such as chiseling or listing may be necessary. Commercial fertilizer will improve yields. These soils are best suited to a sprinkler irrigation system.

CAPABILITY UNIT IIIe-3 (IRRIGATED)

This unit consists of a gently sloping, dark grayish-brown, calcareous fine sandy loam. This soil is moderately rapidly permeable. The only soil in this unit is—

Portales fine sandy loam, 1 to 3 percent slopes.

Cultivated areas of this soil are susceptible to moderate wind and water erosion. The capacity to hold water and plant nutrients is moderate.

Cotton is the main cash crop. Other cash crops are grain sorghum and small grain, which supply residue that helps control wind erosion.

The cropping system should include a high-residue crop on three-fifths of the land each year. A soil-improving crop such as vetch, Austrian winter peas, cowpeas, or alfalfa should be grown on half of the land each year. Crop residue should be managed on the surface for most effective control of erosion in periods when soil blowing is critical. Tillage such as chiseling or listing may also be needed when there is not enough crop residue.

Commercial fertilizer will improve crop yields. Sprinkler irrigation is best suited to this soil.

CAPABILITY UNIT IIIe-4 (IRRIGATED)

The soils in this unit are shallow, reddish-brown to grayish-brown loams and fine sandy loams. They are nearly level to gently sloping. All of them are moderately permeable except Stegall loam, which is slowly permeable. The soils in this unit are—

Arvana fine sandy loam, shallow, 0 to 1 percent slopes.
Lea loam, shallow, 0 to 1 percent slopes.
Mansker fine sandy loam, 0 to 1 percent slopes.
Mansker fine sandy loam, 1 to 3 percent slopes.
Mansker loam, 0 to 1 percent slopes.
Stegall loam, shallow, 0 to 1 percent slopes.

These soils are slightly to moderately susceptible to wind erosion. Those that have 0 to 1 percent slopes are slightly susceptible to water erosion; the others are moderately susceptible. All of these soils have a moderate capacity to hold water and plant nutrients. They are shallow and are often droughty. Often too little residue is produced to control wind erosion.

These soils are best suited to permanent vegetation. Grain sorghum and cotton are the main cash crops.

The cropping system should include a high-residue crop on three-fifths of the land each year. A soil-improving crop such as vetch, Austrian winter peas, or cowpeas, should be grown on half of the land each year.

Crop residue should be managed on the surface for most effective control of erosion during periods when soil blowing is critical. If there is not enough residue to control erosion, tillage such as chiseling may be necessary. These soils need commercial fertilizer. They need small frequent applications of irrigation water. Consequently, irrigation is more costly on these than on other soils. Sprinkler irrigation is best suited.

CAPABILITY UNIT IIIe-5 (IRRIGATED)

In this unit are yellowish-red, moderately to moderately rapidly permeable sandy soils. These soils are nearly level to gently sloping. The soils in this unit are—

Brownfield fine sand, thin surface.
Springer and Brownfield soils, moderately shallow.

These soils are highly susceptible to wind erosion. The sandy surface soil has a low capacity for holding water and fertility. Wind erosion is difficult to control.

Grain sorghum is the main cash crop, but some cotton is grown. Because cotton provides little protective stubble, areas planted to cotton are generally the first to start blowing in spring.

These soils are best suited to perennial grasses. Even when there is adequate moisture, plant growth is limited in many places by the low fertility of these soils.

On soils that have been deep plowed successfully, the cropping system should include high-residue crops and soil-improving crops on half the land. On soils that have not been deep plowed, a high-residue crop should be grown each year. A soil-improving crop should be grown 1 year in 2.

The crop residue should be managed on the surface for most effective control of wind erosion during periods when soil blowing is critical. Tillage such as chiseling or listing may be needed when crop residue is not adequate. Commercial fertilizer will help improve crop yields. Sprinkler irrigation is the only type suited to these soils.

CAPABILITY UNIT IIIes-1 (IRRIGATED)

The soils in this capability unit are light-gray to grayish-brown, shallow to moderately deep, calcareous loams. They are nearly level to gently sloping. The soils in this unit are—

Arch complex.
Arch loam, thin surface.
Drake soils, 1 to 3 percent slopes.

The hazard of water erosion is slight on Arch loam and moderate on the Drake soils. The Arch and the Drake soils are moderately susceptible to wind erosion. The soils in this unit have a moderate capacity to store water. They contain large amounts of free lime. The lime slows the release of plant nutrients, especially iron, and lack of iron frequently causes the leaves of grain sorghum to turn yellow.

In dry-farmed areas these soils are best suited to permanent vegetation. Grain sorghum and some small grain are grown. In irrigated areas cotton, alfalfa, sweetclover, vetch, Austrian winter peas, cowpeas, and guar are successfully grown.

The cropping system should keep a high-residue crop on two-thirds of the land each year. A soil-improving crop should be grown on half of the land each year. The crop residue should be kept on the surface in periods when soil blowing is critical. Tillage such as chiseling will help to control wind erosion when there is not enough crop residue.

Commercial fertilizer can be added to improve yields and to increase the residue. Deep-rooted legumes and grasses help improve or maintain yields. Sprinkler irrigation is the most efficient system of applying water to these soils.

CAPABILITY UNIT IVe-1 (IRRIGATED)

The soils in this capability unit are nearly level to gently sloping, reddish-yellow to grayish-brown fine sands. These soils are deep and moderately deep and are moderately to moderately rapidly permeable. The soils in this unit are—

Brownfield fine sand, thick surface.
Gomez fine sand.

These soils are highly susceptible to wind erosion and are slightly susceptible to water erosion. They have a low capacity for holding water and plant nutrients. They have deep sandy surface layers; therefore, deep plowing is not practical.

It is not practical to cultivate these soils for dryland farming, though the soils are suited to perennial grasses. In irrigated areas limited amounts of grain sorghum, small grain, and perennial grasses may be grown in drilled or closely spaced rows.

High-residue crops, planted in close-spaced rows, should be included in the cropping system. A soil-improving crop should be grown on half of the land each year. Crop residues should be managed on the surface to control erosion.

Emergency tillage such as chiseling is needed in places to control wind erosion. Fertilizer is very effective in maintaining crop production. Sprinkler irrigation is the only type that is suited to these soils.

Estimated Yields

The yields on a soil reflect, at least in part, the level of management it has had. If yields have been consistently high, the soil probably has been properly managed. In addition to keeping yields high, good management conserves the soil and may even improve it. The farmers of Yoakum County manage their soils at different levels of management. Consequently, the yields vary from farm to farm.

In table 2 are estimated yields of cotton and grain sorghum on soils managed at a low level and at a high level. If the soil is both dry farmed and irrigated, yields produced under each method are given. If only one method is practical, yields produced under this method are given.

TABLE 2.—*Estimated average yields per acre for cotton and grain sorghum*

Soil	A. Low-level management				B. High-level management			
	Cotton (lint)		Grain sorghum		Cotton (lint)		Grain sorghum	
	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Amarillo fine sandy loam, 0 to 1 percent slopes	140	500	800	2, 500	175	750	1, 200	4, 000
Amarillo fine sandy loam, 1 to 3 percent slopes	130	450	700	1, 700	160	700	1, 000	3, 400
Amarillo loamy fine sand, 0 to 3 percent slopes	125	500	700	1, 500	175	750	1, 000	3, 500
Amarillo loamy fine sand, thin solum, 0 to 3 percent slopes	125	500	700	2, 500	160	650	1, 100	5, 700
Arch loam, thin surface	70	175	400	1, 200	(1)	400	500	2, 000
Arch complex	100	350	500	1, 500	115	450	650	2, 500
Arvana fine sandy loam, 0 to 1 percent slopes	125	450	650	2, 000	160	700	1, 000	3, 200
Arvana fine sandy loam, 1 to 3 percent slopes	120	375	600	1, 200	175	600	900	2, 500
Arvana fine sandy loam, shallow, 0 to 1 percent slopes	55	200	450	1, 200	100	200	600	2, 000
Berthoud-Potter complex	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Brownfield fine sand, thick surface	75	300	400	1, 200	125	300	500	2, 000
Brownfield fine sand, thin surface	110	375	625	1, 400	165	575	900	3, 000
Brownfield soils, severely eroded	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Brownfield-Tivoli fine sands	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Drake soils, 1 to 3 percent slopes	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Gomez fine sand	90	300	500	1, 200	125	400	600	2, 200
Gomez loamy fine sand	100	400	600	2, 000	150	500	1, 000	3, 600
Kimbrough soils	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Kimbrough-Stegall complex	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Lea loam, shallow, 0 to 1 percent slopes	(1)	220	500	1, 300	(1)	250	750	2, 400
Mansker fine sandy loam, 0 to 1 percent slopes	75	220	500	1, 300	(1)	250	750	2, 400
Mansker fine sandy loam, 1 to 3 percent slopes	60	200	400	1, 200	(1)	220	700	2, 400
Mansker loam, 0 to 1 percent slopes	(1)	200	450	1, 200	(1)	250	700	2, 400
Portales fine sandy loam, 0 to 1 percent slopes	135	475	700	1, 700	160	700	1, 100	3, 600
Portales fine sandy loam, 1 to 3 percent slopes	100	450	550	1, 500	150	650	900	3, 400
Portales loam, 0 to 1 percent slopes	100	500	600	1, 800	160	700	1, 050	4, 200
Randall clay	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Springer and Brownfield soils, moderately shallow	120	450	650	1, 500	165	700	900	2, 800
Springer and Brownfield soils, shallow	60	150	350	800	100	300	800	2, 000
Spur and Bippus soils	150	600	700	2, 400	200	700	1, 100	4, 000
Stegall loam, 0 to 1 percent slopes	100	450	500	1, 800	150	700	1, 000	3, 600
Stegall loam, shallow, 0 to 1 percent slopes	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Tivoli-Potter complex	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Zita fine sandy loam, 0 to 1 percent slopes	160	550	900	2, 000	200	800	1, 000	4, 000
Zita loam, 0 to 1 percent slopes	145	500	800	1, 800	180	800	1, 000	4, 000

[1] Crop is seldom, if ever, grown, or the soil is not suited to its production.

In Yoakum County many crops other than cotton and grain sorghum are grown; however, yields for these crops are not given because their acreages are so small that reliable data are not available.

The yields for dryland farming do not apply to the extreme southwestern part of the county. This part is transitional to an area of lower rainfall, and there is not enough dryland farming practiced there to give a reliable basis for estimating yields.

The yields in table 2 were obtained through interviews with farmers, from records of experiment stations and other agricultural agencies, and from data from surrounding counties having similar soils and climate.

The practices used on dryland at a low level of management are as follows:

1. Water is not properly conserved.
2. Soil-improving crops are not used in rotation.
3. Tillage alone is used to control wind erosion.

The practices used on irrigated soils at a low level of management are as follows:

1. Water is not conserved.
2. Crop residue is turned under.
3. Erratic irrigation is used.
4. Fertilizer is not used or is used haphazardly.

The practices used on dryland at a high level of management are as follows:

1. Water that falls on the land is saved.
2. Soil-improving and high-residue crops are used in the crop rotation.
3. Residue is used to help control wind erosion.

The practices used on irrigated soils at a high level of management are as follows:

1. Rainfall is saved and crops are watered according to crop needs.
2. Fertilizer is used in amounts determined by soil tests and crop needs.
3. Crop residue is used to help control wind and water erosion.
4. Soil-improving and high-residue crops are used in the rotation.

Practically all the farmers in Yoakum County use a high level of insect and weed control.

Range Management [2]

Livestock production is the second largest agricultural enterprise in the county. The success of this enterprise depends on the way ranchers manage their rangeland. Much of the rangeland in the county is now producing only one-fourth or less of the forage it normally produces when the range is in good or in excellent condition.

Approximately 302,600 acres in Yoakum County are in range. Of this rangeland, about 222,000 acres is made up of large areas of deep sandy soils; 28,700 acres, of areas of limy soils; and 51,900 acres, of areas of sandy loams. The rest is made up of shallow and bottom-land soils in areas scattered throughout the county.

[2] By ALTON T. WILHITE, JR., range conservationist, Soil Conservation Service.

The vegetation on the sandy soils was originally sand bluestem and little bluestem, giant dropseed, side-oats grama, and some shin oak. A good stand of side-oats grama, blue grama, black grama, and buffalograss grew on the sandy loams and limy soils.

Because of overstocking or drought, or both, undesirable plants have replaced most of the palatable grasses. On the sandy soils, shin oak has replaced the tall and mid grasses. On the sandy loams, mesquite and the woody plants have replaced the mid and short grasses; and on the limy soils, broom snakeweed has replaced the mid and short grasses.

Range sites and condition classes

Different kinds of rangeland produce different kinds and amounts of grass. In order to manage rangeland properly, a rancher should know the different kinds of soil on his ranch and the plants that will grow on each soil. Then he can use management that will produce the best forage plants.

A range site is a kind of rangeland that differs significantly from other rangeland in its capacity to produce different kinds and amounts of climax, or original, vegetation. The difference between two range sites must be enough to require different use and management on the sites to maintain or improve the grasses. The climax vegetation of a range site is that combination of plants that originally grew on the site. Generally, it is the most productive combination of forage plants that will grow on the site.

On the range sites, native plants are referred to as decreasers, increasers, and invaders. Decreasers are plants in the climax vegetation that decrease under grazing that is continuous and moderately heavy to heavy. Increasers are plants in the climax vegetation that normally increase as the decreasers decline. Invaders are plants that normally are insignificant or lacking in the climax vegetation, but that will invade if increasers are heavily grazed continuously.

A rancher can estimate the range condition if he knows the composition of the climax vegetation. If soils are placed in range sites, the grasses can be named that make up the climax vegetation in each site. Then the condition of the range can be determined by comparing the existing vegetation with the climax vegetation.

Range condition is expressed as follows:

Condition class:	*Percentage of climax vegetation on the site*
Excellent	76–100
Good	51–75
Fair	26–50
Poor	0–25

The nine range sites in this county are Deep Sand, Sandy Land, Sandy Plains, Mixed Land, Mixed Plains, High Lime, Deep Hardland, Shallow Land, and Bottom Land (fig. 14).

Four or five grasses are generally dominant when a range site is in excellent condition. For example, on the Deep Sand site, when in excellent condition, sand bluestem, giant dropseed, giant sandreed, and little bluestem make up more than 60 percent of the total forage. The site, therefore, is producing nearly its maximum amount of forage when these grasses are dominant. Many other

Figure 14.—A, **Deep Sand range site in good condition;** ***B,*** **Sandy Land range site in excellent condition;** ***C,*** **Sandy Plains range site in fair condition;** ***D,*** **Mixed Land range site in good condition;** ***E,*** **Deep Hardland range site in good condition;** ***F,*** **Bottom Land range site in good condition.**

grasses grow on the Deep Sand site in small amounts. If the grasses on a site are similar in kind and in proportion to those in the climax vegetation, the site will probably produce high yields for a long time.

In the following discussion of each range site, estimated yields of range forage are given. These estimates are reported in terms of air-dry weight per acre and are based on averages of several locations and range conditions over a period of years. The estimates take into account years with below average and above average rainfall.

DEEP SAND RANGE SITE

This range site consists of large sand dunes and lower lying, level to gently sloping areas between the dunes (see fig. 14*A*). The dunes are as much as 20 feet high and have choppy slopes of about 40 percent. Many blowout spots are on the southwestern side of the dunes. The soils are sandy, and there is no runoff. The following soils are in this range site—

Brownfield fine sand, thick surface.
Brownfield soils, severely eroded.
Brownfield-Tivoli fine sands.

The climax vegetation consists of 60 to 70 percent decreasers and 30 to 40 percent increasers. The decreasers are mainly sand bluestem, giant dropseed, giant sandreed, and little bluestem. The increasers are mainly sand dropseed, perennial three-awn, and Havard oak. The common invaders are false buffalograss and annuals.

The average annual production of grazable forage per acre ranges from about 225 pounds (dry weight) on areas of this site in poor condition to about 750 pounds (dry weight) on those in excellent condition.

SANDY LAND RANGE SITE

This range site is undulating and normally occurs on nearly level to gently sloping plains (see fig. 14*B*). Because the soils are sandy, they readily take in water, and there is little runoff. No drainage patterns are formed. The following soils are in this range site—

Amarillo loamy fine sand, 0 to 3 percent slopes.
Amarillo loamy fine sand, thin solum, 0 to 3 percent slopes.
Brownfield fine sand, thin surface.
Gomez fine sand.
Springer and Brownfield soils, moderately shallow.
Springer and Brownfield soils, shallow.

Included in this site are small, insignificant areas of the Tivoli-Potter complex. The soils of this complex actually form a separate range site, but because of their small acreage and association with the other soils, they are listed with this one.

The climax vegetation consists of 65 to 75 percent decreasers and 25 to 35 percent increasers. The decreasers are mainly giant dropseed, little bluestem, side-oats grama,

mesa dropseed, and plains bristlegrass. The increasers are mainly hooded windmillgrass, fall witchgrass, sand dropseed, perennial three-awn, and Havard oak. The common invaders are annuals.

The average annual production of grazable forage per acre ranges from about 265 pounds (dry weight) on areas of this site in poor condition to about 950 pounds (dry weight) on those in excellent condition.

SANDY PLAINS RANGE SITE

This range site is generally in nearly level, slight depressions within much larger areas of Brownfield soils (see fig. 14*C*). The depressions receive runoff from surrounding areas. In a few places this site makes up broad expanses of gently sloping, undulating plain. The following soil is in this range site—

Gomez loamy fine sand.

On this site the climax vegetation consists of 65 to 75 percent decreasers and 25 to 35 percent increasers. The decreasers are mainly side-oats grama, blue grama, cane bluestem, plains bristlegrass, and Arizona cottontop. The increasers are mainly black grama, hooded windmillgrass, sand dropseed, and perennial three-awn. The common invaders are sand sage and annuals.

The average annual production of grazable forage per acre ranges from about 300 pounds (dry weight) on areas of this site in poor condition to about 1,050 pounds (dry weight) on those in excellent condition.

MIXED LAND RANGE SITE

This range site normally occurs in broad areas of nearly level to gently sloping soils of the upland (see fig. 14*D*). Drainage patterns are immature, as most of the drainage is into shallow playas. The following soils are in this range site—

Amarillo fine sandy loam, 0 to 1 percent slopes.
Amarillo fine sandy loam, 1 to 3 percent slopes.
Arvana fine sandy loam, 0 to 1 percent slopes.
Arvana fine sandy loam, 1 to 3 percent slopes.
Arvana fine sandy loam, shallow, 0 to 1 percent slopes.
Zita fine sandy loam, 0 to 1 percent slopes.

The climax vegetation consists of 65 to 75 percent decreasers and 25 to 35 percent increasers. The decreasers are mainly side-oats grama, cane bluestem, blue grama, Arizona cottontop, and plains bristlegrass. The increasers are mainly black grama, buffalograss, hooded windmillgrass, and sand dropseed. The common invaders are mesquite and annuals.

The average annual production of grazable forage per acre ranges from about 300 pounds (dry weight) on areas of this site in poor condition to about 1,125 pounds (dry weight) on those in excellent condition.

MIXED PLAINS RANGE SITE

This range site occupies broad, level to nearly level plains consisting of permeable, calcareous soils. Drainage patterns are immature; most of the drainage is into ancient lakes. The following soils are in this range site—

Lea loam, shallow, 0 to 1 percent slopes.
Mansker fine sandy loam, 0 to 1 percent slopes.
Mansker fine sandy loam, 1 to 3 percent slopes.
Mansker loam, 0 to 1 percent slopes.
Portales fine sandy loam, 0 to 1 percent slopes.
Portales fine sandy loam, 1 to 3 percent slopes.
Portales loam, 0 to 1 percent slopes.

The climax vegetation consists of 65 to 75 percent decreasers and 25 to 35 percent increasers. The decreasers are mainly side-oats grama, cane bluestem, blue grama, and vine-mesquite. The increasers are mainly black grama, sand dropseed, and perennial three-awn. The common invaders are sand muhly, ring muhly, broom snakeweed, and annuals.

The average annual production of grazable forage per acre ranges from about 300 pounds (dry weight) on areas of this site in poor condition to about 1,050 pounds (dry weight) on those in excellent condition.

HIGH LIME RANGE SITE

In this range site are the highly calcareous soils on convex, sloping eolian dunes, generally on the east and northeast sides of ancient lakebeds. It also includes the soils that occupy the lower lying, sloping areas of these dunes. The following soils are in this range site—

Arch complex.
Arch loam, thin surface.
Drake soils, 1 to 3 percent slopes.

The climax vegetation usually consists of 65 to 75 percent decreasers and 25 to 35 percent increasers. Because of erosion and salinity, however, the climax vegetation differs in some areas around salt lakes. In areas adjacent to the lakes, only salt-tolerant vegetation may grow, but as the distance from the lakes increases, the vegetation is increasingly less tolerant to salt. On most of this site the decreasers are mainly side-oats grama, blue grama, and vine-mesquite. The increasers are mainly black grama, sand dropseed, three-awn, and alkali sacaton. The common invaders are sand muhly and annuals.

The average annual production of grazable forage per acre ranges from about 225 pounds (dry weight) on areas of this site in poor condition to about 825 pounds (dry weight) on those in excellent condition.

DEEP HARDLAND RANGE SITE

This range site normally occurs on nearly level to gently sloping plains (see fig. 14*E*). The water from these plains generally drains into large playas. This site consists of the following soils—

Stegall loam, 0 to 1 percent slopes.
Zita loam, 0 to 1 percent slopes.

Also included in this site are small areas of Randall clay, which if they made up a larger total acreage would be recognized as a separate range site. Because of the small acreage of this soil and its association with other soils, no special range site has been set up for it.

The climax vegetation consists of 55 to 65 percent decreasers and 35 to 45 percent increasers. The decreasers are mainly side-oats grama, blue grama, cane bluestem, and vine-mesquite. The increasers are mainly tobosagrass, buffalograss, and perennial three-awn. The common invaders are mesquite and annuals.

The average annual production of grazable forage per acre ranges from about 300 pounds (dry weight) on areas of this site in poor condition to about 1,125 pounds (dry weight) on those in excellent condition.

SHALLOW LAND RANGE SITE

This range site consists of shallow soils. It occurs throughout the county among large areas of deep soil or

on slopes that grade into ancient draws. In this site are the following soils—

Kimbrough soils.
Kimbrough-Stegall complex.
Stegall loam, shallow, 0 to 1 percent slopes.

Also in this site are some soils of the Berthoud-Potter complex. The major soils of that complex are actually in another more favorable range site; but because the areas and also the total acreage are small, a special site for the soils of this complex has not been set up.

The climax vegetation consists of 70 to 75 percent decreasers and 25 to 30 percent increasers. The decreasers are mainly side-oats grama, black grama, cane bluestem, and New Mexican feathergrass. The increasers are mainly hairy grama, slim tridens, sand dropseed, and perennial three-awn. The common invaders are broom snakeweed and annuals.

The average annual production of grazable forage per acre ranges from about 225 pounds (dry weight) on areas of this site in poor condition to about 750 pounds (dry weight) on those in excellent condition.

BOTTOM LAND RANGE SITE

This range site occurs in narrow draws that are on flats or in nearly level areas (see fig. 14*F*). It receives runoff from adjoining sites even when the rainfall is light. The following soils are in this range site—

Spur and Bippus soils.

The climax vegetation of this site consists of 60 to 70 percent decreasers and 30 to 40 percent increasers. The decreasers are mainly side-oats grama, cane bluestem, silver bluestem, white tridens, and plains bristlegrass. The increasers are mainly vine-mesquite, blue grama, and buffalograss. The common invaders are mesquite and annuals.

The average annual production of grazable forage per acre ranges from about 500 pounds (dry weight) on areas of this site in poor condition to about 3,000 pounds (dry weight) on those in excellent condition.

Management principles and practices

Good range management increases the palatable, native plants in the forage and also conserves soil and water. The grazing should be so regulated that grass can grow and reproduce and provide maximum yields for grazing animals. The essential stages in the growth and reproduction of grass are leaf development, root growth, the formation of flower stalks, seed production, forage regrowth, and the storage of food in roots.

Livestock graze selectively. They constantly seek the decreasers, which are generally the more palatable and more nutritious plants. If grazing is not carefully regulated, the decreasers are eliminated and the increasers, or less desirable plants, multiply. If grazing is continued, the increasers are thinned out, or eliminated, and the undesirable invaders replace them.

Research and the experience of ranchers have shown that when about half the yearly volume of grass is grazed, damage to the better plants is minimized and the range is improved. The half of the forage left on the ground has the following effects:

1. It serves as a mulch that allows a rapid intake and storage of water. The more water stored in the ground, the better the grass grows.
2. It allows roots to reach deep moisture. (Grass that is heavily grazed cannot reach deep moisture because not enough green shoots are left to provide the food needed for good root growth.)
3. It protects the soil from wind and water erosion. Grass is the best kind of cover for protection against erosion.
4. It allows the better grass to crowd out weeds.
5. It enables plants to store food for quick and vigorous growth after droughts and in spring.
6. It provides for greater feed reserves for the dry spells and prevents the sale of underweight livestock at a loss.

Range management requires that grazing be kept in balance with the growth of forage from season to season. Reserve pastures or other food for livestock should be provided during droughts or other periods of low forage production. Thus the forage can be moderately grazed at all times. It is often desirable to keep part of the livestock, such as stocker steers, readily salable. The rancher can then keep the number of livestock in balance with the available forage without the sale of breeding animals at a loss.

Grazing should be so regulated that adequate protective cover and the most desirable grasses are maintained. If the range has deteriorated, the grazing intensity should be lessened or grazing should be deferred so that the quality and quantity of the grasses are improved.

The number of livestock should be kept in balance with the amount of forage produced. This can be done by regulating the grazing according to the quantity and quality of the most palatable, or key, plants. The key plants usually make up 10 percent or more of the vegetation, and the condition of the range can be judged by observing them.

The following practices should be used to get the most benefit from forage plants:

1. Enough leaf and stem growth should be left to manufacture plant food.
2. Grazing should be regulated during the early development of plants to permit accumulation and storage of plant foods. Close grazing decreases the yields and reduces the root growth of most plants and may eventually eliminate the desirable ones.
3. The characteristics of all plants on the range should be considered to determine how much forage is available, when it is ready to be grazed, and how long it should be grazed.

Generally, it is considered safe to let animals graze about 50 percent of the total volume of the current growth of the key plants. If this is done, 75 to 90 percent of the growth of the less palatable plants may be left. Properly regulated grazing at the end of the grazing season will leave a stubble 1½ to 2 inches high on short grasses, 4 to 7 inches on mid grasses, and 7 to 10 inches on tall grasses.

Much of the rangeland in Yoakum County is in fair or poor condition. The grazing on this rangeland should be deferred so that the vigor of the forage stand can increase. When grazing is deferred, the most desirable plants produce seed, reproduce, and can grow without the hindrance of grazing pressure. The time to defer grazing depends on the season of growth and the period of seed development of the desirable plants.

On most farms and ranches, it is not practical to defer grazing on all parts of the rangeland in the same year. Some parts can be rested while other parts are grazed. Because animals eat the seed stalks and flowers of key grasses and allow the poorer grasses to increase, all livestock should be kept off the range during the rest period. The benefits of the rest period are lessened, however, if parts of the rangeland are overgrazed while other parts are being rested. Over a period of years, all the rangeland benefits from rest periods in the growing season. As the more palatable plants increase in number, their vigor improves and the available forage increases.

The following management practices are needed for range in this county:

Range seeding.—Seeding to perennial or improved grasses is needed on ranges in poor condition. This practice will help control runoff and erosion. A range generally needs seeding if the climax vegetation is less than 10 percent of the stand, or if the desirable grasses are so depleted that they cannot reseed and spread naturally. Cropland on which erosion cannot be controlled should be seeded to grass.

Brush control.—Brush should be controlled if it makes up more than 10 percent of the total vegetation. Mesquite and shin oak are particularly troublesome in the county. On some range sites, the grass is so suppressed by brush that it does not protect the soil from erosion and does not supply satisfactory forage. Some areas need brush control before the condition of the range can be improved. Brush can be controlled by chemical or mechanical means.

Water distribution.—Points where water is available to livestock should be located close enough so that the animals do not have to walk far for a drink. Reasonable walking distances for cattle are 1 mile on sandy areas and 2 miles on smooth, flat areas. Well-spaced watering points will help to keep the range grazed evenly. Most ranges in Yoakum County have adequate wells that are the only source of water for livestock on ranges.

Fencing.—Most of the rangeland in Yoakum County is adequately fenced to allow control of livestock and regulation of grazing. Additional cross-fences could be built within some fenced areas to permit deferred and seasonal grazing.

Engineering Interpretations of the Soils[3]

In this section some of the ways that engineers can use the soil report are pointed out and the engineering soil classification systems are discussed. Brief descriptions of the soils and estimates of their engineering properties—particularly those related to highway construction and agricultural engineering—are given in table 3. The soils are evaluated for specific engineering uses in table 4.

Information in this report can be used to

1. Make soil and land-use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in planning agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, and storage areas and in planning detailed investigations at selected locations.
4. Locate probable sources of sand, gravel, topsoil, and other construction materials.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes in the particular area.

This report will not eliminate the need for, or take the place of, on-site sampling and testing of soils for design and construction of specific engineering works. The report can be useful in planning more detailed field surveys to determine the in-place condition of the soil at the site of the proposed construction.

Some of the terms used by the soil scientist may be unfamiliar to the engineer, and some words have special meanings in soil science. These terms are defined in the Glossary.

Engineering Classification Systems

The soil material in the horizons of a typical profile for each soil type is classified in three systems—USDA, Unified, and AASHO.

The USDA system is the textural classification used by the Soil Conservation Service in soil surveys.

The Unified classification (*7*) was developed at the Vicksburg Waterways Experiment Station by the Corps of Engineers, U.S. Army. In this system soil material is put in 15 classes that are designated by pairs of letters. These classes range from GW, which consists of well-graded gravel, gravel and sand mixtures, and a little fine material, to Pt, which consists of peat and other highly organic soils. The soils of this county have been classified only in the SP, SM, SC, ML, CL, and CH classes of material.

Many highway engineers classify soil material according to the AASHO method (*1*). This method was approved by the American Association of State Highway Officials. In this system, soil materials are classed in seven principal groups. The groups range from A–1, consisting of soils that have high bearing capacity, to A–7, consisting of clayey soils having low strength when wet.

Explanation of Engineering Tables

This section consists of two tables (tables 3 and 4) and a discussion of some of the terms used in the tables.

The information in tables 3 and 4 is based on tests by the Texas State Highway Department on samples from

[3] This section by LEE H. WILLIAMSON, area engineer, Soil Conservation Service, Big Spring, Tex.

TABLE 3.—*Brief descriptions of the soils*

Map symbol	Soil	Description	Depth from surface
			Inches
AfA AfB	Amarillo fine sandy loam, 0 to 1 percent slopes. Amarillo fine sandy loam, 1 to 3 percent slopes.	8 to 14 inches of fine sandy loam over 30 to 40 inches of moderately permeable, well-drained sandy clay loam; developed on unconsolidated, moderately sandy alluvial and eolian sediments.	0–14 14–43 43–68
AmB AnB	Amarillo loamy fine sand, 0 to 3 percent slopes. Amarillo loamy fine sand, thin solum, 0 to 3 percent slopes.	9 to 14 inches of loamy fine sand over 24 to 36 inches of moderately permeable, well-drained sandy clay loam; developed on unconsolidated, moderately sandy alluvial and eolian sediments; soft caliche is 30 inches or more beneath the surface, but in the thin solum, 26 to 30 inches.	0–14 14–64 64–96
Aa Ac	Arch loam, thin surface Arch complex.	6 to 8 inches of well-drained, strongly calcareous loam; developed from chalky earth that consists of old alluvium or plains outwash; apparently modified by calcium carbonate deposited by ground water; occupy broad valleys and benches around intermittent lakes on the southern High Plains; Arch complex contains areas of Portales and of Mansker soils.	0–7 7–60
AvA AvB AwA	Arvana fine sandy loam, 0 to 1 percent slopes. Arvana fine sandy loam, 1 to 3 percent slopes. Arvana fine sandy loam, shallow, 0 to 1 percent slopes.	8 to 12 inches of fine sandy loam over 14 to 26 inches of moderately permeable, well-drained sandy clay loam; developed on a thin, sandy, eolian mantle deposited over indurated caliche.	0–7 7–18 18+
Be	Berthoud soils of the Berthoud-Potter complex.	0 to 12 inches of calcareous loam over 12 to 38 inches moderately rapidly permeable, well-drained calcareous clay loam, over strongly calcareous clay loam, over a thick layer of whitish, soft caliche.	0–14 14–30 30–60
Sp	Bippus soils of the Spur and Bippus soils	0 to 18 inches of noncalcareous clay loam over moderately permeable, well-drained calcareous clay loam; developed over soft caliche.	0–14 14–38 38–60
Br	Brownfield fine sand, thick surface	20 to 40 inches of fine sand; if not eroded, overlies 20 to 30 inches of well-drained, moderately permeable sandy clay loam; developed from sandy earth that appears to be eolian; in some places hard caliche is at a depth of 3 to 7 feet.	0–24 24–68 68–96
Bt3 Bv	Brownfield soils, severely eroded Brownfield soils of Brownfield-Tivoli fine sands.	0 to 40 inches of fine sand over 20 to 30 inches of well-drained, moderately permeable sandy clay loam; developed from sandy earth that appears to be eolian.	0–40 40–68 68–96
Bs	Brownfield fine sand, thin surface	0 to 16 inches of fine sand over 20 to 30 inches of well-drained, moderately permeable sandy clay loam; developed from sandy earth that appears to be eolian; in some places hard caliche is at a depth of 3 to 7 feet.	0–16 16–84 84–96
DrB	Drake soils, 1 to 3 percent slopes	0 to 12 inches of strongly calcareous, well-drained fine sandy loam; developed from eolian deposits from playas in the southern High Plains.	0–8 8–36 36–74
Gf Gl	Gomez fine sand Gomez loamy fine sand.	12 to 20 inches of loamy fine sand over 8 to 20 inches of well-drained, slightly more clayey material; underlain by strongly calcareous sandy material that may be saturated with water during periods of high rainfall.	0–12 12–26 26–48
Km Ks	Kimbrough soils Kimbrough soils of Kimbrough-Stegall complex.	0 to 8 inches of loam over hard, platy caliche	0–8 8–60
LeA	Lea loam, shallow, 0 to 1 percent slopes	0 to 9 inches of well-drained calcareous loam over moderately permeable, calcareous clay loam over a bed of strongly cemented caliche.	0–9 9–16 16–20
MfA MfB	Mansker fine sandy loam, 0 to 1 percent slopes. Mansker fine sandy loam, 1 to 3 percent slopes.	4 to 10 inches of fine sandy loam over medium- to fine-textured sediments; underlain by strongly calcareous sandy material that may be saturated with water during periods of high rainfall.	0–10 10–17 17–36
MkA	Mansker loam, 0 to 1 percent slopes	4 to 10 inches of well-drained loam to clay loam; developed from strongly calcareous, medium- to fine-textured sediment of High Plains outwash material; occurs on High Plains and rolling plains.	0–10 10–17 17–40

See footnotes at end of table.

and their estimated physical properties

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Texture USDA	Unified[1]	AASHO[2]	No. 4	No. 10	No. 200				
						Inches per hour	*Inches per inch of depth*	*pH*	
Fine sandy loam	SM	A-2 or A-4	[3] 100	[3] 100	[3] 25–45	1.0–2.0	0.12	7.5–7.8	Low to moderate.
Sandy clay loam	SC or CL	A-4 or A-6	[3] 100	[3] 100	[3] 33–53	0.5–1.0	0.16	7.5–8.0	Low to moderate.
Sandy clay loam	SC or CL	A-2, A-4, or A-6.	[4] 50–100	[4] 45–100	[4] 20–70	0.5–1.0	0.04	8.0–8.4	Low to moderate.
Loamy fine sand	SM	A-2	[3] 100	[3] 100	[3] 15–20	1.5–5.0	0.08	7.2–7.7	Low.
Sandy clay loam	SM or SC	A-2 or A-6	[3] 100	[3] 100	[3] 30–40	0.5–1.5	0.16	7.5–8.0	Low to moderate.
Sandy clay loam	SC	A-2, A-4, or A-6.	[3] 100	[3] 100	[3] 30–40	0.5–1.5	0.08	8.0–8.5	Low to moderate.
Clay loam [5]	CL [5]	A-4	[6] 100	[6] 55–80	[6] 55–80	0.2–0.8	0.18	8.0+	Moderate.
Clay loam [5]	CL [5]	A-6	[6] 100	[6] 55–80	[6] 55–80	0.2–0.8	0.18	8.0+	Moderate.
Fine sandy loam [5]	SM [5] or ML	A-2 or A-4	[6] 100	[6] 45–85	[6] 30–60	1.0–2.0	0.12	7.5–7.8	Low to moderate.
Sandy clay loam [5]	SM, SC, or ML [5].	A-2, A-4, or A-6 [5].	[6] 100	[6] 45–80	[6] 20–55	0.5–1.5	0.16	7.5–7.8	Low to moderate.
Hard caliche	----	----	----	----	----	----	0.04	8.0+	Low.
Clay loam [5]	CL [5]	A-4 [5]	[6] 100	[6] 20–45	[6] 55–80	0.2–0.8	2.1	7.8–8.0	Moderate.
Clay loam [5]	CL [5]	A-6 [5]	[6] 100	[6] 85–100	[6] 55–80	0.2–0.8	2.1	8.0+	Moderate.
Clay loam [5]	CL [5]	A-6 [5]	[6] 100	[6] 85–100	[6] 55–80	0.2–0.8	0.5	8.0+	Moderate.
Clay loam [5]	ML	A-4 [5]	[6] 97	[6] 95	[6] 85	1.0–1.5	2.4	7.5–7.8	Moderate.
Clay loam [5]	ML	A-4 [5]	96	82	70	0.4–0.8	2.0	7.5–8.2	Moderate.
Clay loam [5]	CL	A-4, A-6, or A-7 [5].	90	85	70	0.5–1.0	2.0–1.2	7.5–8.2	Moderate.
Loamy fine sand	SM	A-2	[3] 100	[3] 100	[3] 15–20	5.0+	0.06	7.5	Low.
Sandy clay loam	SC	A-2 or A-6	[3] 100	[3] 100	[3] 25–40	0.5–1.5	0.16	7.2–7.8	Low to moderate.
Fine sandy loam	SM	A-2 or A-4	[3] 100	[3] 100	[3] 25–40	1.0–2.0	0.12	7.2–8.0	Low to moderate.
Fine sand	SM	A-2	[6] 100	[6] 100	[6] 12	1.5–3.0	1.0–1.4	6.5–7.0	Low to moderate.
Sandy clay loam	SC	A-6	100	100	39	1.5–3.0	1.5	7.0–7.5	Low to moderate.
Sandy clay loam	SC or CL	A-6	100	100	42–58	1–5–3.0	1.4	7.0–7.5	Low to moderate.
Loamy fine sand	SM	A-2	[4] 100	[4] 100	[4] 15–20	5.0+	0.06	7.6	Low.
Sandy clay loam	SC	A-6	[4] 100	[4] 100	[4] 35–40	0.5–1.5	0.16	7.2–7.9	Low to moderate.
Fine sandy loam	SC	A-6	[4] 100	[4] 100	[4] 35–40	1.0–2.0	0.12	7.2–8.3	Low to moderate.
Clay loam [5]	CL [5]	A-4	[6] 100	[6] 55–80	[6] 55–80	0.2–0.8	0.18	8.0+	Moderate.
Clay loam [5]	CL [5]	A-6 [5]	[6] 100	[6] 55–80	[6] 55–80	0.2–0.8	0.18	8.0+	Moderate.
Clay loam [5]	CL [5]	A 6 [5]	[6] 100	[6] 20–45	[6] 55–80	0.2–0.8	0.18	8.0+	Moderate.
Loamy fine sand [5]	SM [5]	A-2	[6] 100	[6] 70–90	[6] 10–30	1.5–5.0	0.08	7.2–7.8	Low.
Fine sandy loam [5]	SM or ML [5]	A-2 or A-4	[6] 100	[6] 45–85	[6] 15–55	1.0–2.0	0.12	7.5–8.0+	Low to moderate.
Sandy clay loam (caliche).	SC or CL	A-4 or A-6	[6] 100	[6] 45–80	[6] 35–60	0.5–1.5	0.04	8.0+	Low to moderate.
Light clay loam	CL	A-4	[6] 96	[6] 94	[6] 56	0.5–1.0	1.2–1.5	6.5–7.0	Low.
Hard caliche	----	----	----	----	----	----	----	----	Low.
Loam	CL	A-4	[6] 96–100	[6] 94–100	[6] 56–59	0.5–1.0	2.0	8.0–8.5	Moderate.
Clay loam	CL	A-6	99	98	64	0.5–1.0	2.0	8.0–8.5	Moderate.
Hard caliche	CL	A-4	86–99	83–98	56–77	0.5–1.0	0.8	----	Moderate.
Fine sandy loam [5]	SM or ML [5]	A-2 or A-4 [5]	[6] 100	[6] 45–85	[6] 15–55	1.0–2.0	0.12	7.5–8.0	Low to moderate.
Sandy clay loam [5]	SM, SC, or CL [5].	A-2 or A-6 [5].	[6] 100	[6] 45–80	[6] 20–55	0.5–1.5	0.04–0.12	8.0+	Low to moderate.
Sandy clay loam [5]	SC or CL [5]	A-6	[6] 100	[6] 80–100	[6] 35–60	0.5–1.5	0.04	8.0+	Low to moderate.
Clay loam	CL	A-4 or A-6	[4] 95–100	[4] 95–100	[4] 55–65	0.2–0.8	0.18	7.5–8.0	Moderate.
Clay loam	CL	A-4 or A-6	[4] 95–100	[4] 95–100	[4] 55–65	0.2–0.8	0.18	8.0+	Moderate.
Clay loam	CL	A-6	[4] 85–100	[4] 85–100	[4] 55–75	0.2–0.8	0.04	8.0+	Moderate.

TABLE 3.—*Brief descriptions of the soils*

Map symbol	Soil	Description	Depth from surface
			Inches
PfA PfB	Portales fine sandy loam, 0 to 1 percent slopes. Portales fine sandy loam, 1 to 3 percent slopes.	8 to 14 inches of well-drained fine sandy loam; developed from strongly calcareous, medium- to fine-textured sediment of High Plains outwash material; occurs on High Plains and rolling plains.	0–14 14–25 25–60
PmA	Portales loam, 0 to 1 percent slopes	6 to 10 inches of calcareous, well-drained, moderately permeable loam to clay loam developed in limy plains sediment; underlain by a thick layer of whitish, soft caliche.	0–10 10–27 27–34
Be, Tx	Potter soils	2 to 10 inches of strongly calcareous, well-drained fine sandy loam; developed on deep beds of soft or only weakly indurated caliche.	0–6 6+
Rc	Randall clay	4 to 5 feet of poorly drained clay on the floors of enclosed depressions or intermittent lakes; occurs on the southern High Plains.	0–10 10–76
So, Sg	Springer soils of Springer and Brownfield soils.	0 to 9 inches of well-drained loamy fine sand over moderately permeable sandy clay loam to fine sandy loam; developed over a thick bed of indurated caliche.	0–9 9–34 34–60
Sp	Spur clay loam of Spur and Bippus soils	4 to 5 feet of well-drained alluvial clay loam on the flood plains of ancient draws on the High Plains.	0–16 16–63 63–78
StA SuA Ks	Stegall loam, 0 to 1 percent slopes Stegall loam, shallow, 0 to 1 percent slopes. Stegall soils of Kimbrough-Stegall complex.	0 to 8 inches of well-drained, noncalcareous loam over slowly permeable, noncalcareous, heavy clay loam; developed over a bed of indurated caliche.	0–8 8–32 32–60
Bv Tx	Tivoli fine sand of Brownfield-Tivoli fine sands. Tivoli soils of the Tivoli-Potter complex.	6 to 7 feet of well-drained fine sand; developed from wind deposits of the Quaternary period.	0–6 6–96
ZfA	Zita fine sandy loam, 0 to 1 percent slopes	6 to 12 inches of fine sandy loam over 14 to 20 inches of well-drained sandy clay loam; developed in highly calcareous, eolian or alluvial material of the High Plains.	0–18 18–33 33–60
ZmA	Zita loam, 0 to 1 percent slopes	0 to 8 inches of noncalcareous, well-drained loam over calcareous, moderately permeable clay loam over soft, white caliche.	0–6 6–30 30–60

[1] Based on "The Unified Soil Classification System, "Technical Memorandum No. 3–357, 2 v. and appendix, Waterways Experiment Station, Corps of Engineers, March 1953, rev. 1957.
[2] Based on "Standard Specifications for Highway Materials and Methods of Sampling and Testing (pt. 1, ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes," AASHO Designation: M 145–49.
[3] Data from tests by Texas State Highway Department on samples from Terry County, Tex.

the soils from Terry County, Tex., and on tests by the Bureau of Public Roads on some samples from Lynn County, Tex. Engineering tests were not made on soil samples from Yoakum County.

Table 3 gives brief descriptions of all the soils in Yoakum County and estimates of some soil properties that are significant to engineering. In this table the classification by grain size under the heading "Percentage passing sieve" is based on data furnished by the Bureau of Public Roads and by the Texas State Highway Department. Where engineering test data for grain size were not available for some soils, the range of grain sizes was estimated on the basis of test data for similar soils and the USDA textural classification.

The column in table 3 headed "Permeability" gives the estimated rate, in inches per hour, that water moves through a soil horizon.

In the column headed "Available water capacity" are estimates, in inches per inch of soil, of the capillary water in the soil when it is wet to field capacity. For example, a layer of Amarillo fine sandy loam, 1 inch thick, will hold 0.12 inch of water soaking down from the surface. If another 0.12 inch is added, another inch of soil will be wetted. In contrast, a layer of Tivoli fine sand, 1 inch thick, will hold only 0.06 inch of water after the excess has drained away.

In the column headed "Reaction," the estimated degree of acidity or alkalinity is expressed as a pH value, which is the common logarithm of the reciprocal of the hydrogen-ion concentration of a solution. A notation of 7.0 pH indicates precise neutrality; higher values indicate increasing alkalinity, and lower values indicate increasing acidity.

"Shrink-swell potential" indicates the volume change of the soil material that can be expected with changes in moisture content. A knowledge of this potential is important in planning the use of a soil for building roads and other engineering structures. The shrink-swell potential was estimated by technicians familiar with the soils of the area.

Because all soils in the county, except Randall clay and the Spur soils, have a very low water table, the depth to

and their estimated physical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Texture USDA	Unified[1]	AASHO[2]	No. 4	No. 10	No. 200				
						Inches per hour	*Inches per inch of depth*	*pH*	
Fine sandy loam	SM or CL	A-2 or A-4	[3] 100	[3] 95–100	[3] 20–55	1. 0–2. 0	0. 12	7. 8–8. 0	Low to moderate.
Sandy clay loam	SM or CL	A-2 or A-6	[3] 100	[3] 100	[3] 35–55	0. 5–1. 5	0. 04–0. 12	8. 0–8. 1	Low to moderate.
Sandy clay loam	SC or CL	A-4 or A-6	[3] 100	[3] 80–95	[3] 40–55	0. 5–1. 5	0. 04	8. 0+	Low to moderate.
Clay loam [5]	CL [5]	A-4 [5]	[6] 100	[6] 55–80	[6] 55–80	0. 2–0. 8	0. 18	7. 8–8. 0	Moderate.
Clay loam [5]	CL [5]	A-6 [5]	[6] 100	[6] 55–80	[6] 55–80	0. 2–0. 8	0. 18	8. 0+	Moderate.
Clay loam [5]	CL [5]	A-6 [5]	[6] 100	[6] 85–100	[6] 55–80	0. 2–0. 8	0. 04	8. 0+	Moderate.
Fine sandy loam [5]	SM or ML	A-2 or A-4	[6] 100	[6] 45–85	[6] 15–55	1. 0–2. 0	0. 12	8. 0+	Low to moderate.
Caliche							0. 04	8. 0+	Low.
Clay	CH	A-7	[4] 100	[4] 100	[4] 80–85	0. 0–0. 2	0. 21	7. 4–8. 0+	High.
Clay	CL	A-7	[4] 100	[4] 100	[4] 80–85	0. 0–0. 2	0. 21	7. 4–8. 0+	High to moderate.
Loamy fine sand	SM	A-2 or A-4	[6] 97–100	[6] 95–100	[6] 15–40	2. 5–5. 0	1. 0	7. 0–7. 2	Low.
Fine sandy loam	SM or ML	A-2, A-4	100	45–85	15–55	1. 0–2. 0	1. 5	7. 0–7. 2	Low to moderate.
Hard caliche							0. 5	8. 0+	
Clay loam [5]	CL [5]	A-4 or A-6	[6] 100	[6] 55–100	[6] 55–80	0. 2–0. 8	0. 18	7. 2–8. 0+	Moderate.
Clay loam [5]	CL [5]	A-4 or A-6[5]	[6] 100	[6] 55–80	[6] 55–80	0. 2–0. 8	0. 18	8. 0+	Moderate.
Clay loam [5]	CL [5]	A-6 [5]	[6] 100	[6] 55–80	[6] 55–80	0. 2–0. 8	0. 18	8. 0+	Moderate.
Loam	CL	A-6	[6] 100	[6] 100	[6] 50–60	0. 5–2. 0	1. 8	7. 0	Moderate.
Heavy clay loam	CL	A-6 or A-7	100	100	70–80	0. 6–1. 0	2. 0	7. 0–7. 5	Moderate to high.
Hard caliche									
Fine sand [5]	SM or SP [5]	A-2 or A-3 [5]	[6] 100	[6] 85–100	[6] 0–15	5. 0–8. 0	0. 06	7. 0–7. 5	Low.
Fine sand [5]	SM or SP [5]	A-2 or A-3 [5]	[6] 100	[6] 85–100	[6] 0–15	5. 0–8. 0	0. 06	7. 0–7. 5	Low.
Fine sandy loam [5]	SM or ML [5]	A-2 or A-4 [5]	[6] 100	[6] 43–85	[6] 15–55	1. 0–2. 0	0. 12	7. 4–7. 8	Low to moderate.
Sandy clay loam [5]	SC or CL [5]	A-2 or A-6 [5]	[6] 100	[6] 45–85	[6] 20–55	0. 5–1. 5	0. 16	7. 6–8. 0	Low to moderate.
Sandy clay loam [5]	SC or CL [5]	A-6 [5]	[6] 100	[6] 45–80	[6] 35–55	0. 5–1. 5	0. 04	8. 0+	Low to moderate.
Loam	CL	A-6	[6] 100	[6] 100	[6] 55–65	1. 0–2. 0	2. 0	7. 5–8. 0	Moderate.
Loam	CL	A-6	100	100	55–65		2. 0	7. 5–7. 8	Moderate.
Loam	CL	A-6	95–100	95–100	50–60		1. 0	8. 0–8. 5	Moderate.

[4] Data from tests by Bureau of Public Roads on samples from Lynn County, Tex.
[5] Classification estimated for modal soil in survey area using test data for soils of similar classification.
[6] Data estimated.

the seasonally high water table is not given in table 3. At times the Spur soils have a high water table.

Soil dispersion is not shown in table 3, since no soil in this county is appreciably affected by dispersion.

In table 4 the soils are evaluated for engineering uses. The interpretations are based on data in table 3, actual test data available, the knowledge of specialists, and information from engineers of the Texas State Highway Department and personnel in construction companies.

If the material is properly placed and compacted, practically all the soils in the county are suitable for road fill. The sandy surface layer of some soils must be graded with the finer textured layers in the profile to make the best road fill. The most difficult soils to place and compact are the sands that do not contain enough fine material for binding. The heavier soils are more easily compacted but may be overcompacted. Overcompaction may cause an unstable fill and a corrugated and uneven surface.

In Yoakum County bedrock is not likely to be reached in ordinary construction. Many soils in the survey area, however, are underlain by hard caliche that can be used for road subgrade and subbase material. If the caliche is properly crushed and graded, it is also suitable as an aggregate for asphalt surfacing.

The suitability of the soil material for road subgrade depends largely on the texture of the soil material. Soils with plastic clay layers have impeded internal drainage and have low stability when wet, hence are rated "Poor." The coarser textured and better graded soils are rated as "Fair." The Kimbrough soils, which consist of shallow loam over caliche, are rated "Good to fair."

The surface layer of almost all the soils in the county can be used for topsoil. Some soils, however, have a thin surface layer that does not supply much topsoil.

A little sand and gravel can be obtained in small, overwash areas. No area, however, is large enough for sand and gravel to be obtained on a commercial basis.

Irrigation water can be applied to the soils in the county by sprinkler or by flooding. The level-border system and the level- or graded-furrow system are suited to the fine- and medium-textured soils. Sprinklers can be used on all the soils in the county.

TABLE 4.—*Engineering*

Soil type and map symbol	Suitability for—		Suitability as source of topsoil
	Road subgrade	Road fill	
Amarillo fine sandy loam (AfA, AfB).	Fair to poor	Satisfactory	Surface layer satistory.
Amarillo loamy fine sand (AmB, AnB).	Fair to poor	Satisfactory	Surface layer satisfactory.
Arch loam (Aa). Arch soil of Arch complex (Ac).	Poor to fair	Satisfactory	Surface layer satisfactory.
Arvana fine sandy loam (AvA, AvB). Arvana fine sandy loam, shallow (AwA).	Fair to poor	Satisfactory	Surface layer satisfactory.
Berthoud soils of Berthoud-Potter complex (Be).	Poor	Poor to fair	Fair
Bippus soils of Spur and Bippus soils (Sp).	Poor	Fair	Surface layer satistory.
Brownfield fine sand, thick surface (Br). Brownfield fine sand of Brownfield-Tivoli fine sands (Bv).	Fair	Satisfactory	Surface layer satisfactory.
Brownfield fine sand, thin surface (Bs).	Poor to fair	Satisfactory	Surface layer satisfactory.
Drake soils (DrB).	Poor to fair	Satisfactory	Surface layer satisfactory.
Gomez fine sand (Gf).	Fair	Satisfactory	Surface layer satisfactory.
Gomez loamy fine sand (Gl).	Fair	Satisfactory	Surface layer satisfactory.
Kimbrough soils (Km). Kimbrough-Stegall complex (Ks).	Good to fair	Satisfactory	Surface layer thin but satisfactory.
Lea loam, shallow (LeA).	Poor to fair	Poor to fair	Fair
Mansker fine sandy loam (MfA, MfB).	Fair to poor	Satisfactory	Surface layer satisfactory.
Mansker loam (MkA).	Poor to fair	Satisfactory	Surface layer satisfactory.
Portales fine sandy loam (PfA, PfB).	Fair to poor	Satisfactory	Surface layer satisfactory.
Portales loam (PmA).	Poor to fair	Satisfactory	Surface layer satisfactory.
Potter soils (Be, Tx).	Fair	Satisfactory	Surface layer satisfactory.
Randall clay (Rc).	Poor	Satisfactory to unsatisfactory.	Poor
Springer soils of Springer and Brownfield soils (Sb, Sg).	Fair to good	Fair	Surface layer poor
Spur soils of Spur and Bippus soils (Sp).	Poor	Satisfactory	Surface layer satisfactory.
Stegall loam (StA). Stegall loam, shallow (SuA).	Poor to fair	Fair	Fair
Tivoli fine sand (Bv).	Fair	Satisfactory	Surface layer satisfactory.
Zita fine sandy loam (ZfA). Zita loam (ZmA).	Fair to poor	Satisfactory	Surface layer satisfactory.

interpretations of the soils

Soil features affecting—		
Irrigation	Field terraces and diversion terraces	Waterways
Moderate permeability; moderate to high water-holding capacity.	Moderate permeability; moderate to high water-holding capacity.	Highly calcareous subsoil.
Moderate permeability; high susceptibility to wind erosion; low water-holding capacity	High susceptibility to wind erosion; poorly graded surface soil.	High susceptibility to wind erosion.
Moderate permeability; low water-holding capacity.	Hazard of wind erosion; moderate permeability; low water-holding capacity.	Moderate permeability; subject to wind erosion; low water-holding capacity.
Moderate permeability; moderate to high water-holding capacity.	Moderate permeability; moderate to high water-holding capacity; substratum is hard caliche.	Highly calcareous subsoil; hard caliche.
Moderate permeability; deep soils; high water-holding capacity.	Moderate permeability; hazard of erosion; high water-holding capacity.	Hazard of erosion; calcareous substratum.
Moderately rapid permeability; moderate water-holding capacity.	Subject to erosion	Subject to erosion.
Moderate permeability; high susceptibility to wind erosion; low water-holding capacity.	High susceptibility to wind erosion; well-graded subsoil.	High susceptibility to wind erosion.
Moderate permeability; high susceptibility to wind erosion; low water-holding capacity.	High susceptibility to wind erosion; poorly graded surface soil.	High susceptibility to wind erosion.
Moderately rapid permeability; high susceptibility to wind erosion; low water-holding capacity.	Poor stability; high susceptibility to wind erosion; highly calcareous subsoil.	High susceptibility to wind erosion; highly calcareous subsoil.
Moderately rapid permeability; high susceptibility to wind erosion; low water-holding capacity.	Poor stability	High susceptibility to wind erosion; highly calcareous subsoil.
Moderately rapid permeability; high susceptibility to wind erosion; low water-holding capacity.	Poor stability; high susceptibility to wind erosion; highly calcareous subsoil.	High susceptibility to wind erosion; highly calcareous subsoil.
Moderately rapid permeability; very shallow.	Very shallow surface layer, less than 10 inches in depth.	Very shallow surface layer, stony throughout profile.
Low intake rate; low water-holding capacity.	Slight erosion	Slightly erodible.
Shallow; low water-holding capacity	Shallow; soft caliche near surface; low water-holding capacity.	Shallow; soft caliche near surface; fair stability.
Shallow; low water-holding capacity	Shallow; soft caliche near surface	Shallow; soft caliche near surface; moderate susceptibility to wind erosion.
Moderately rapid permeability; moderate water-holding capacity.	Poor stability; highly calcareous subsoil	Highly calcareous subsoil.
Moderate permeability; deep soil; high water-holding capacity.	Moderate permeability; hazard of erosion; high water-holding capacity.	Hazard of erosion; calcareous substratum.
Moderate to rapid permeability; very shallow.	Very shallow; soft caliche very near the surface; stony.	Very shallow; caliche very near surface; stony.
Very slow permeability; hazard of flooding	Very slow permeability; hazard of flooding; subject to cracking.	Subject to cracking; hazard of flooding.
Low water-holding capacity	Very high wind erosion	Very high hazard of wind erosion.
Hazard of flooding; shallow water table	Hazard of flooding	Hazard of flooding.
Low intake rate	No problems	Erodible.
Moderately rapid permeability; high susceptibility to wind erosion; low water-holding capacity.	Low stability; hazard of wind erosion	Hazard of wind erosion; sandy.
Moderate permeability; moderate to high water-holding capacity.	Moderate permeability; highly calcareous substratum.	Highly calcareous substratum.

Field terraces and diversion terraces can be constructed on most soils in the county but are difficult to maintain on the coarser textured soils. The terrace ridges and channels are difficult to keep in good condition. Some of the soil material accumulates in channels, and some is blown out of the ridges by wind.

Wind erosion is also a great hazard to waterways constructed in the area. Windblown materials accumulate in waterways and smother the vegetation, as well as hinder the flow of water.

Generally, the soils in Yoakum County are not suitable for ponds. The top layers of many soils may be suitable for the construction of pond fills, but the underlying layers will not hold water in the reservoir areas.

All the soils in the county can be graded in winter, as long periods of subfreezing weather probably will not occur. Though the Spur soils are likely to be wet, they are not likely to be hard to grade.

Genesis, Classification, and Morphology of the Soils

This section presents the outstanding morphologic characteristics of the soils of Yoakum County and relates them to the factors of soil formation. Physical and chemical data on the soils are limited, however, and the discussions of soil genesis and morphology are correspondingly incomplete. The first part of the section deals with the environment of the soils; the second, their classification; and the third, their morphology.

Factors of Soil Formation

Soil is a function of climate, living organisms, parent materials, topography, and time. The nature of the soil at any point on the earth depends upon the combination of the five major factors at that point. All five of these factors come into play in the genesis of every soil. The relative importance of each differs from place to place. In some places one is important, and in other places some other factor is important. In extreme cases one factor may dominate in the formation of the soil and fix most of its properties, as is common when the parent material consists of pure quartz sand. Little can happen to quartz sand, and the soils derived from it usually have faint horizons. Even in quartz sand, however, distinct profiles can be formed under certain types of vegetation where the topography is low and flat and a high water table is present. Thus, for every soil the past combination of the five major factors is of the first importance to its present character.

The interrelationships among the factors of soil formation are complex, and the effects of any one factor cannot be isolated and identified with certainty. It is convenient, however, to discuss the factors of soil formation separately and to indicate some of their probable effects. The reader should always remember that the factors interact continually in the processes of soil formation and that the interactions are important to the nature of every soil.

Climate.—Precipitation, temperature, humidity, and wind have been important in the development of the soils of Yoakum County. The wet climate of past geologic ages influenced the deposition of parent materials. Later, as a result of limited rainfall that seldom wet the soil below the area of living roots, most of the zonal and intrazonal soils have a horizon of calcium carbonate. Many of the younger soils have free lime throughout the profile because not enough rainwater has passed through them to leach out the lime.

Wind is an outstanding factor in the development of soils in this area. It has affected soil development from the time it deposited sands over preexisting alluvial materials in the Illinoian stage of the Pleistocene to its present shifting of coarse sands on the surface.

Living organisms.—Vegetation, micro-organisms, earthworms, and other forms of life that live on and in the soil contribute to its development. The type and amount of vegetation are important. They are determined partly by the climate and partly by the kind of parent material. Climate limited the vegetation of Yoakum County to grasses. The parent material determined whether the grasses would be tall, as on the sands, or short, as on the clays.

The mixed prairie type of native vegetation contributed large amounts of organic matter to the soil. Decaying grass leaves and stems distributed this organic matter on the soil surface. Decomposition of the fine roots distributed it throughout the solum. The network of tubes and pores left by these decaying roots hastened the passage of air and water through the soil and provided abundant food for bacteria, actinomycetes, and fungi.

Earthworms are the most noticeable animal life in the soil. Despite the low rainfall in this area and periods when the entire solum is dry, the importance of earthworms in soil development is easily seen. About 40 percent of some of the B2 horizons of the Amarillo soils are worm casts. Worm casts add greatly to the movement of air, water, and plant roots in a soil.

Soil-dwelling rodents have had a part in the development of some soils. Farmers who occupied the land since it was in native grass know where large prairie-dog towns thrived. The burrowing of these animals did much to offset the leaching of free lime from the soil. It destroyed soil structure that was already formed. A good example of such soils occurs within large areas of Amarillo soils. In contrast to the Amarillo soils around them, these soils are calcareous to the surface, have weaker structure in the subsoil, and have weaker calcium carbonate horizons in many places. These soils have characteristics of the Portales soils and were mapped as such.

The influence of men on soil formation should not be ignored. At first men fenced the range, brought livestock, and permitted the range to be overgrazed. They then plowed the land to plant crops. By harvesting crops and allowing runoff and wind erosion, they reduced the amount of organic matter and the silt and clay particles in the plow layer. Through the use of heavy machinery and poorly timed tillage, men produced compacted areas that reduced infiltration of water and aeration. They have drastically changed the moisture regimes in some areas by irrigating. These things that have occurred in the past 50 years have shown marked effects on the soils of the county.

The way that men treat the soil in future generations will affect the further development.

Parent materials.—All the soils of Yoakum County were developed from Rocky Mountain outwash materials

deposited in the Quaternary and late Tertiary periods. Wind has reworked most of the outwash since the alluvium was originally deposited. The parent materials are largely alkaline to calcareous, unconsolidated sandy and silty earths.

The lime content in some areas has been increased by a high water table. Some shallow, enclosed basins have received lime from surrounding slopes.

The texture of the parent materials greatly influences soil development. Soils that have developed from fine-textured materials generally have developed more rapidly and to a greater degree than soils that have developed from coarse-textured materials.

Relief.—Relief influences soil development through its effect on drainage and runoff. The degree of profile development depends mainly on the average amount of moisture in the soil, provided other factors of soil formation are equal. The soils on steep slopes absorb less moisture and normally have less well-developed profiles than soils on flats and in depressions. Besides, the soil-forming processes on steep slopes are retarded by continuous erosion.

Time.—Many characteristics of a soil are determined by the length of time that the soil-forming factors have acted upon the soil. Some materials that have been in place for only a short time have not been influenced enough by climate and living organisms to develop well-defined and genetically related horizons. The eolian dunes bordering playas are examples.

The soils on steep slopes are immature because geologic erosion has removed the effects of soil formation. The soils that have been in place for a long time and have approached equilibrium with their environment are mature, or old, soils. These soils show marked horizon differentiations. They are well-drained soils that occupy the nearly level to gently sloping areas of the county.

Classification of Soils by Higher Categories

Soils are placed in narrow classes for the organization and application of knowledge about their behavior within farms, ranches, or counties. They are placed in broad classes for study and comparisons of large areas, such as continents. In the comprehensive system of soil classification followed in the United States (*2*), the soils are placed in six categories, one above the other. Beginning at the top, the six categories are order, suborder, great soil group, family, series, and type.

In the highest category, the soils of the whole country are grouped into three orders, whereas thousands of soil types are recognized in the lowest category. The suborder and family categories have never been fully developed and thus have been little used. Attention has been given largely to the classification of soils into soil types and series within counties or comparable areas and to the subsequent grouping of series into great soil groups and orders. Soil series, type, and phase are defined in "How Soils are Named, Mapped, and Classified" and in the Glossary in the back of the report. The subdivisions of soil types into phases provides finer distinctions significant to use and management.

Classes in the highest category of the classification scheme are the zonal, intrazonal, and azonal orders (*5*). Because of the way in which the soil orders are defined, all three can usually be found within a single county, as is true in Yoakum County. Two of the orders, and sometimes all three of them, may occur in a single field.

The great soil group is the next lower category beneath the order that has been widely used. Classes in that category have been used to a very great extent because they indicate a number of relationships in soil genesis and also indicate something of the fertility status of soils, their suitability for crops or trees, and the like.

Each great soil group consists of a large number of soil series that have many internal features in common. Thus, all members of a single great soil group, if in either the zonal or intrazonal order, have the same number and kind of definitive horizons in their profiles. These definitive horizons need not be expressed to the same degree, nor do they need to be of the same thickness in all soils within one great soil group. Specific horizons must be recognizable, however, in every soil profile of a soil series representing a given great soil group.

In the following list, the soil series are classified by orders and great soil groups. Following the list is a discussion of the morphology of each series and a description of a typical profile for each.

ZONAL ORDER:
- Reddish Chestnut soils:
  - Amarillo
  - Arvana
- Chestnut soils:
  - Bippus
  - Lea
  - Stegall
  - Zita
- Reddish-Brown soils:
  - Brownfield
  - Springer

INTRAZONAL ORDER:
- Calcisols:
  - Arch
  - Gómez
  - Mansker
  - Portales
- Grumusols:
  - Randall

AZONAL ORDER:
- Alluvial soils:
  - Spur
- Lithosols:
  - Kimbrough
  - Potter
- Regosols:
  - Berthoud
  - Drake
  - Tivoli

Zonal order

The zonal order comprises soils with evident, genetically related horizons that reflect the dominant influence of climate and living organisms in their formation. These soils are nearly in equilibrium with their environment. In Yoakum County this order includes the Reddish Chestnut, Chestnut, and Reddish-Brown great soil groups.

The Reddish Chestnut soils have a dark-brown, pinkish- or reddish-tinted surface layer, as much as 2 feet thick, over a finer textured reddish-brown soil, over grayish or pinkish lime accumulation. The soil series of Yoakum County in this great soil group are the Amarillo and Arvana.

The Chestnut soils have a dark-brown surface layer that grades to lighter colored material, which in turn grades to a horizon of lime accumulation. In this county the soil series in this group are the Bippus, Lea, Stegall, and Zita.

The Reddish-Brown soils have a light-brown surface horizon of a slightly reddish cast that grades to dull reddish-brown or red material heavier than the surface layer. This heavier material grades to a horizon of whitish or pinkish lime accumulation. In this county the

soil series in this group are the Brownfield and Springer.

Amarillo soils are somewhat similar to Arvana soils, but the Amarillo developed in a thick bed of parent material, and the Arvana in thin. The Arvana, Lea, and Stegall soils all developed in a thin layer of parent material deposited over relict, indurated caliche. In fact, the Arvana and Stegall soils are less than 36 inches in thickness.

Brownfield soils developed from more sandy and less calcareous parent material than that of the Amarillo and Arvana soils.

Zita soils have developed from strongly calcareous material. They normally occupy slightly depressional areas, as do the Stegall soils.

The Bippus soils have a calcareous loamy subsoil that developed from calcareous parent material. Springer soils have developed from less clayey parent material than Amarillo soils.

Intrazonal order

In the intrazonal order are soils with evident, genetically related horizons that reflect the dominant influence of a local factor of topography or parent material over the effects of climate and living organisms. The length of time that these soils have been developing and the relief have much to do in determining the kind of soils that develop. Generally, these soils do not have a B horizon, or at best, have a weak, textural B horizon. The horizon sequence is A, AC, Cca, C, and D. In Yoakum County this order contains the Calcisol and Grumusol great soil groups.

Calcisols are a group of soils having an A horizon variable in thickness and color, a prominent deeper horizon of lime accumulation, and parent material with a high to very high content of carbonates. The series in this group in this county are the Arch, Gomez, Mansker, and Portales.

Grumusols have relatively uniform texture and are high in montmorillonite clay. Swelling and shrinking continually churn the soil. During shrinking, the soil "swallows itself," as dry soil that has fallen into the cracks is mixed with the lower lying material. The native cover is mid and short grasses. The Randall soils are the only Grumusols in the county.

The Gomez, Mansker, and Portales soils are medial Calcisols. The Arch soils are minimal Calcisols. The Mansker soils normally have developed on very gently sloping ridges where not so much water percolates through the profile as through the profile of the adjacent, lower lying, nearly level Portales soils. The Gomez soils have developed in a more sandy parent material than that of the Arch, Mansker, and Portales soils.

Azonal order

The azonal order includes soils that lack distinct, genetically related horizons, commonly because of resistant parent material or steep topography. In Yoakum County this order contains the Alluvial soils, Lithosols, and Regosols.

Alluvial soils are soils developing from transported and relatively recently deposited material (alluvium) showing little or no modification by soil-forming processes. The Spur soils are the only Alluvial soils in this county. They have developed on recent alluvium, and except in the A1 horizon, show little horizon differentiation.

Lithosols are soils that have a thin solum. The series in this group in this county are the Kimbrough and Potter.

Regosols are soils that do not have distinct horizons and have developed from deep unconsolidated or soft rocky deposits. In this county they include the Berthoud, Drake, and Tivoli series. The Drake are young soils that have formed in material that was fairly recently blown from nearby playas and deposited in crescent-shaped dunes. The Tivoli soils have developed from siliceous materials that contain only a small amount of minerals that can be weathered. The Berthoud soils have a calcareous loamy subsoil and lack distinct genetic horizons, except for a weak A1 horizon.

Morphology

This section has been prepared for soil scientists and others who need more detailed descriptions of the soils in this county than are given elsewhere in the report. In the following pages each soil series is described. A typical profile of a soil type in each series is described in detail, and ranges of important characteristics of the soils within the series are stated.

Amarillo series.—This series consists of moderately sandy, Reddish Chestnut soils. These soils developed in unconsolidated, alluvial, and eolian sediments that were moderately sandy and calcareous.

The A horizon is reddish brown and ranges in texture from fine sandy loam to loamy fine sand. The B horizon is a reddish, noncalcareous sandy clay loam (fig. 15).

The Amarillo soils are less sandy and darker than the Brownfield. They have a Cca horizozn that the Brownfield soils lack. They are redder than the associated calcareous Portales soils that occupy the more nearly level, slightly lower areas.

The Amarillo soils are extensive in the east-central part of the county.

Typical profile of Amarillo loamy fine sand on a slope of about 1 percent (0.55 mile north and 100 feet west of the southeast corner of section 257, 6 miles north of Plains on Highway No. 214, then 6 miles east on a paved county road):

A1p—0 to 14 inches, brown (7.5YR 4/4) loamy fine sand, dark brown (7.5YR 3/4) when moist; structureless; loose when dry, nearly loose when moist, and nonsticky when wet; common fine roots; 20 percent small clods plowed up from horizon below; noncalcareous; neutral; abrupt boundary.

B21 14 to 24 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; compound weak, prismatic and weak, subangular blocky structure; hard when dry, friable when moist, and sticky when wet; many fine roots and common medium roots; common medium insect casts and burrows; many fine tubes and pores; clay films and organic staining on surfaces of the peds; noncalcareous; neutral; clear boundary.

B22—24 to 40 inches, yellowish-red (5YR 5/8) sandy clay loam, yellowish red (5YR 4/8) when moist; compound weak to moderate, very coarse, prismatic and weak, subangular blocky structure; hard when dry, friable when moist, and sticky when wet; few fine roots; common very fine tubes and pores; noncalcareous; neutral; gradual boundary.

Figure 15.—**A profile of Amarillo fine sandy loam showing the structure of the subsoil above the calcareous parent material.**

B3 –40 to 64 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; weak, subangular blocky structure; hard when dry, friable when moist, and sticky when wet; few threads and films of calcium carbonate; strongly calcareous; clear boundary.

Cca—64 to 76 inches, pink (7.5YR 7/4) sandy clay loam, light brown (7.5YR 6/4) when moist; hard when dry, friable when moist, and sticky when wet; many fine and common medium concretions of calcium carbonate; very strongly calcareous; gradual boundary.

C—76 to 96 inches +, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; hard when dry, friable when moist, and sticky when wet; few very fine and fine concretions of calcium carbonate; strongly calcareous.

Range in characteristics.—The A horizon ranges from 8 to 16 inches in thickness, and from fine sandy loam to loamy fine sand in texture. The color ranges from reddish brown to dark brown, hue 5YR to 7.5YR, value 4 to 6, and chroma 3 to 6.

The B horizon ranges from 20 to 80 inches in thickness. The color ranges from red to reddish yellow, hue 2.5YR to 7.5YR, value 3 to 6, and chroma 2 to 8.

If present, the B3 horizon is weakly calcareous and contains a few threads and films of calcium carbonate. In places it is strongly calcareous.

The Cca horizon ranges from 4 to 12 inches in thickness. The color is pink, hue 5YR to 7.5YR, value 7 to 8, and chroma 3 to 4.

The depth to the C horizon ranges from 56 to more than 96 inches. The color ranges from reddish yellow to pink, hue 5YR to 7.5YR, value 5 to 7, and chroma 3 to 6.

Arch series.—This series consists of grayish, strongly calcareous, medium-textured, shallow soils. These soils are in the Calcisol great soil group. They are nearly level and smooth. The parent material is a chalky earth of old alluvium. This alluvium was modified by deposition of calcium carbonate from ground water.

The A horizon is grayish-brown loam or fine sandy loam, 5 to 10 inches thick. It overlies a shallow Cca horizon, 4 to 12 inches thick.

The Arch soils are lighter colored, more calcareous, and shallower than the Mansker and Portales.

The Arch soils occupy large flats in the west-central part of Yoakum County between Plains and Bronco.

Typical profile of Arch loam (0.3 mile north and 0.5 mile west of the southeast corner of section 338, 5 miles northwest of Plains, Tex., on U.S. Highway No. 380 in a small, triangular fenced-in area west of a caliche pit):

A1—0 to 7 inches, light brownish-gray (10YR 6/2) loam, grayish brown (10YR 5/2) when moist; compound weak, prismatic and weak, subangular blocky structure; slightly hard when dry, friable when moist, and sticky when wet; few medium roots, tubes, and pores and common fine roots, tubes, and pores; few medium and common fine insect casts and burrows; few, fine, angular fragments of calcium carbonate on surface and throughout horizon; very strongly calcareous; gradual boundary.

Cca—7 to 31 inches, white (10YR 8/2) clay loam, light gray (10YR 7/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist, and sticky when wet; contains about 40 percent, by volume, of white (10YR 8/1), soft, segregated calcium carbonate; common medium roots, tubes, and pores and many fine roots, tubes, and pores; few large insect casts and burrows; very strongly calcareous; diffuse boundary.

C—31 to 60 inches +, very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) when moist; porous and friable; very strongly calcareous.

Range in characteristics.—The A horizon ranges from 5 to 10 inches in thickness. The color ranges from grayish brown to light brownish gray, hue 10YR to 2.5Y, value 5 to 7, and chroma 2 to 4.

The Cca horizon ranges from 4 to 12 inches in thickness. The color ranges from light gray to white, hue 10YR to 2.5Y, value 6 to 8, and chroma 1 or 2.

In places indurated caliche occurs at a depth of 36 to 60 inches.

Arvana series.—This series consists of moderately deep, moderately sandy, moderately permeable Reddish Chestnut soils. These soils are reddish, noncalcareous loamy soils on hard, platy caliche (fig. 16). The Arvana soils probably developed from a thin, sandy eolian mantle that was deposited over preexisting caliche. The B horizon is a reddish sandy clay loam.

The Arvana are associated with the Amarillo and Kimbrough soils. They occur with the Amarillo soils along ridgetops. They are shallower than the Amarillo soils, which are underlain by unconsolidated parent material. They have a thinner solum (12 to 36 inches thick) over hard, platy caliche. The Arvana are deeper than the Kimbrough soils and, in many places, surround small areas of the Kimbrough soils on gradual slopes below ridgetops. They are of minor extent in Yoakum County.

Figure 16.—**Typical profile of Arvana fine sandy loam showing the hard, platy caliche.**

Typical profile of Arvana fine sandy loam on a slope of about 1 percent (0.3 mile east and 0.3 mile south of the northwest corner of section 342, 10 miles northwest of Plains on U.S. Highway No. 380, then south 0.3 mile on dirt road):

A1—0 to 9 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; structureless; soft when dry, very friable when moist, and slightly sticky when wet; many fine roots, tubes, and pores and common medium roots, tubes, and pores; noncalcareous; clear boundary.

B21—9 to 21 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; compound moderate, coarse, prismatic and weak, subangular blocky structure; hard when dry, friable when moist, and sticky when wet; many fine roots, tubes, and pores; many fine insect casts and burrows; noncalcareous; clear boundary.

B22—21 to 34 inches, yellowish-red (5YR 4/8) sandy clay loam, yellowish red (5YR 3/8) when moist; weak, subangular blocky structure; consistence as in B21 horizon; common fine roots, tubes, and pores; few insect casts and burrows; noncalcareous; clear boundary.

D—34 inches +, indurated caliche.

Range in characteristics.—The A horizon ranges from 8 to 12 inches in thickness. It ranges from reddish brown to brown in color, hue 5YR to 7.5YR, value 4 to 6, and chroma 2 to 6.

The B21 horizon ranges from 10 to 20 inches in thickness and from yellowish red to reddish brown in color, hue 5YR, value 3 to 5, and chroma 3 to 8.

The B22 horizon ranges from 8 to 16 inches in thickness. The color is yellowish red, hue 5YR, value 4 to 5, and chroma 6 to 8. The B22 horizon usually is one or two units higher in chroma than the B21.

Berthoud series.—This series consists of brown to grayish-brown, moderately deep, calcareous soils. These soils are in the Regosol great soil group. They were developed from slope colluvium and alluvium that was washed from the higher lying soils.

The Berthoud soils occupy the long, very narrow foot slopes that follow the slope contours of the draws and are just above the Spur soils in the bottoms of the draws. These foot slopes are below the higher lying Potter soils along the edges of the draws.

The A horizon is 6 to 20 inches thick. It ranges from brown to light brownish gray in color and from loam to fine sandy loam in texture. The AC horizon is 20 to 30 inches thick. It ranges from very pale brown to light yellowish brown in color and from loam to clay loam in texture. The C horizon occurs at a depth of 30 to 50 inches. It ranges from white to very pale brown in color and from loam to clay loam in texture.

Associated with the Berthoud soils are the Mansker, which are shallower, and the Spur, which are darker and deeper and are alluvial.

The Berthoud soils are mapped in complex with the Potter soils and are of minor extent.

Typical profile of a Berthoud soil on a slope of about 5 percent (0.1 mile west and 0.1 mile north of the southeast corner of section 426, 1 mile northwest of Plains, Tex., on U.S. Highway No. 380):

A1—0 to 12 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; weak, prismatic structure; slightly hard when dry, very friable when moist, and slightly sticky when wet; many fine roots and common medium roots; common fine tubes and pores; common fine and few medium, subrounded fragments of calcium carbonate; strongly calcareous; clear boundary.

AC—12 to 38 inches, light yellowish-brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) when moist; moderate, medium, prismatic structure; hard when dry, friable when moist, and slightly sticky when wet; many very fine roots, tubes, and pores and common fine roots, tubes, and pores; many fine and medium and common, coarse, subrounded fragments of calcium carbonate in horizontal pockets, 2 to 3 inches wide and 8 to 10 inches long, and also distributed throughout the horizon; very strongly calcareous; diffuse boundary.

C—38 to 48 inches, very pale brown (10YR 7/4) light clay loam, light yellowish brown (10YR 6/4) when moist; very slightly hard when dry, friable when moist, and slightly sticky when wet; few fine roots; very strongly calcareous.

Bippus series.—This series consists of deep, dark, well-drained, moderately permeable soils. These soils are in the Chestnut great soil group. They occupy concave, lower parts of alluvial, intermittent draws that cross the county.

The parent material is strongly calcareous alluvium that is clay loam in texture and that was washed from nearby slopes. This material is underlain mostly by calcareous sediment.

The Bippus soils are associated and intermingled with the Spur soils and are mapped as the Spur and Bippus soils in an undifferentiated unit. They have less distinct horizons and occupy lower elevations than the Zita soils.

Typical profile of Bippus clay loam (0.2 mile east and 0.1 mile north of the southwest corner of section 429, 1 mile east of Plains Tex., on U.S. Highway No. 380):

A1—0 to 18 inches, very dark grayish-brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) when moist; compound moderate, coarse, prismatic and moderate, fine, subangular blocky structure; hard when dry, firm

when moist, and very sticky when wet; many fine insect casts, worm casts, and burrows; many fine roots; noncalcareous; gradual boundary.

AC—18 to 30 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; weak, subangular blocky structure; hard when dry, firm when moist, and very sticky when wet; few fine concretions and few threads and films of calcium carbonate; strongly calcareous; diffuse boundary.

Cca—30 to 48 inches +, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; hard when dry, firm when moist, and very sticky when wet; many medium and common, fine concretions of calcium carbonate; common insect casts and burrows; very strongly calcareous.

Range in characteristics.—The A horizon ranges from 8 to 24 inches in thickness. It is very dark brown to grayish brown, hue 10YR, value 2 to 5, and chroma 2.

The AC horizon is brown to light-brown clay loam and ranges from 10 to 20 inches in thickness.

Brownfield series.—This series consists of soils that have a loose sandy A horizon and a friable, noncalcareous sandy clay loam subsoil that is moderately permeable. The subsoil does not have a horizon of calcium carbonate accumulation. These soils are in the Reddish-Brown great soil group.

The parent materials are eolian, reddish fine sandy loam and sandy clay loam. In some areas they overlie a relict layer of soft or semi-indurated caliche that is 10 feet below the surface. In these areas the entire mantle was subject to soil-forming processes that left no identifiable parent material. The parent materials also appear to be outwash materials that were reworked by wind.

These soils have nearly level to gently sloping and undulating (0 to 3 percent), convex slopes. The A horizon is yellowish-red to reddish-yellow fine sand, 10 to 40 inches thick. The B horizon is yellowish-red to red, noncalcareous sandy clay loam, 40 to 70 inches thick.

The Brownfield are associated with the Amarillo, Gomez, and Tivoli soils. They have a thicker and sandier surface layer and a redder subsoil than the Amarillo soils. Also, they have a sandy clay loam subsoil, but the Tivoli soils are sandy throughout the profile. The Brownfield have a less smooth topography than the Amarillo soils. They do not have a horizon of calcium carbonate accumulation, as do the Amarillo soils. The Gomez soils have a less clayey subsoil than the Brownfield. Also, the Gomez soils have a calcareous subsoil.

The Brownfield soils, the most extensive in the county, occur throughout it. They are used for range. Large areas, however, are cultivated. Grain sorghum and cotton are grown in both dry-farmed and irrigated areas.

Typical profile of Brownfield fine sand on a slope of about 1 percent (0.5 mile west and 100 feet south of the northeast corner of section 451, 8.5 miles west of Plains, Tex., on the old Lovington Highway):

Ap—0 to 16 inches, yellowish-red (5YR 5/6) fine sand, yellowish red (5YR 4/6) when moist; structureless; loose when dry, nearly loose when moist, and nonsticky when wet; common fine roots and few medium roots; organic stains in the upper 4 inches; noncalcareous; clear boundary.

B21—16 to 54 inches, red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) when moist; compound moderate, coarse, prismatic and weak, subangular blocky structure; hard when dry, friable when moist, and sticky when wet; many fine roots in upper 20 inches; few small tubes; no evidence of insect activity; noncalcareous; gradual boundary.

B22—54 to 84 inches, red (2.5YR 5/8) sandy clay loam, red (2.5YR 4/8) when moist; weak, subangular blocky structure; consistence as in B21 horizon; noncalcareous; gradual boundary.

C—84 to 96 inches +, red (2.5YR 5/8), heavy fine sandy loam, red (2.5YR 4/8) when moist; slightly hard when dry, very friable when moist, and slightly sticky when wet; few threads and films of calcium carbonate at a depth of 90 to 96 inches.

Range in characteristics.—The thickness of the A horizon ranges from 12 to 36 inches. The color ranges from reddish yellow to yellowish red, hue 5YR, value 4 to 7, and chroma 6 to 8.

The thickness of the B21 horizon ranges from 20 to 40 inches. The color ranges from red to reddish yellow, hue 2.5YR to 5YR, value 4 to 6, and chroma 6 to 8.

The thickness of the B22 horizon ranges from 20 to 40 inches. The color ranges from red to yellowish red, hue 2.5YR to 5YR, value 4 to 6, and chroma 6 to 8. The chroma is generally higher than in the B21 horizon.

The color of the C horizon ranges from red to yellowish red, hue 2.5YR to 5YR, value 4 to 5, and chroma of 8. The texture ranges from sandy clay loam to fine sandy loam.

Drake series.—This series consists of strongly calcareous Regosols that were formed from eolian, calcareous fine sandy loams to clay loams (fig. 17). These soils consist of stabilized dunes that usually occur on the east and north sides of playas. The lower lying associated soils are the Arch, Randall, and Portales. The Drake soils are

***Figure 17.*—A typical profile of Drake soils showing the strongly calcareous parent material.**

on steeper slopes than the Arch soils and are lighter colored and more calcareous than the Portales.

The mapped areas have long, narrow, crescent-shaped, convex slopes that range from 2 to 4 percent.

The A horizon is a loam or a fine sandy loam. The subsoil is a very strongly calcareous clay loam.

Typical profile of Drake fine sandy loam (0.2 mile north and 100 feet east of the southwest corner of section 390, 0.75 mile north of the courthouse in Plains, Tex.):

A1—0 to 8 inches, grayish-brown (10YR 5.5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak prismatic structure to structureless; soft when dry, very friable when moist, and slightly sticky when wet; many fine roots, tubes, and pores; strongly calcareous; gradual boundary.

AC—8 to 36 inches, white (10YR 8/2) clay loam, light gray (10YR 7/2) when moist; compound very weak, prismatic and weak, subangular blocky structure; slightly hard when dry, friable when moist, and sticky when wet; common fine roots; many fine tubes and pores; common medium insect casts and burrows; strongly calcareous; diffuse boundary.

C—36 to 74 inches +, very pale brown (10YR 8/3), heavy clay loam, very pale brown (10YR 7/3) when moist; very few fine roots; very strongly calcareous.

Range in characteristics.—The color of the A horizon ranges from light gray to grayish brown, hue 10YR, value 5 to 7, and chroma 1 to 2. The thickness ranges from 6 to 10 inches.

The color of the AC horizon ranges from white to light brownish gray, hue 10YR, value 6 to 8, and chroma 2. The C horizon ranges from 26 to 40 inches in depth. Some mapped areas of this soil have an accumulation of 4 to 6 inches of loamy fine sand.

Gomez series.—In this series are moderately deep, light-colored sandy Calcisols that have a moderately sandy subsoil. The soils are moderately rapidly permeable. The parent material consists of unconsolidated sandy eolian-lacustrine sediments (fig. 18). It is strongly calcareous.

These soils occupy lower lying flats in large areas of Brownfield soils. They are in nearly level, low depressional areas that have slightly concave slopes of less than 2 percent.

The A horizon ranges from fine sand to loamy fine sand in texture and from 10 to 24 inches in thickness.

The Gomez soils are sandier throughout than the Portales. They are less red, more calcareous, less clayey, and more permeable than the Brownfield soils. They are more calcareous and less red than the Springer soils.

These soils are of minor extent and comprise about 2 percent of the acreage of the county.

Typical profile (0.1 mile east of the northwest corner of section 118, 6 miles north of Bronco, Tex., just east of the State line):

A1—0 to 17 inches, brown (10YR 5/3) fine sand, brown (10YR 4/3) when moist; structureless; loose when dry, nearly loose when moist, and nonsticky when wet; few very fine roots, common fine roots, and few medium roots noncalcareous; clear boundary.

AC—17 to 37 inches, light-gray (10YR 7/2) fine sandy loam, light brownish gray (10YR 6/2) when moist; structureless; soft when dry, very friable when moist, and slightly sticky when wet; few very fine roots and few fine roots; weakly to strongly calcareous; clear boundary.

Cca—37 to 55 inches, white (10YR 8/1), light sandy clay loam, light gray (10YR 7/1) when moist; structureless to weak, subangular blocky structure; soft to slightly hard when dry, friable when moist, and sticky when wet; common fine concretions and fragments of calcium carbonate; very strongly calcareous; clear boundary.

C—55 to 66 inches +, light-gray (10YR 7/2), light fine sandy loam, light brownish gray (10YR 6/2) when moist; soft when dry, very friable when moist, and slightly sticky when wet; few very fine concretions of calcium carbonate; strongly calcareous.

Figure 18.—**A typical profile of Gomez fine sand showing the calcareous parent material.**

Range in characteristics.—The thickness of the A horizon ranges from 12 to 24 inches. The color ranges from dark grayish brown to brown, hue 10YR, value 4 to 5, chroma 2 to 3.

The AC horizon ranges from 10 to 24 inches in thickness. The color ranges from light gray to very pale brown, hue 10YR, value 5 to 7, and chroma 2 to 4.

The Cca horizon ranges from 8 to 24 inches in thickness. The color ranges from white to light brownish gray, hue 10YR, value 6 to 8, and chroma 1 to 2.

The depth to the C horizon ranges from 36 to 60 inches. The color is white to light brownish gray, hue 10YR, value 6 to 8, and chroma 1 to 2.

Kimbrough series.—This series consists of very shallow, moderately dark, noncalcareous or weakly calcareous soils. These soils are in the Lithosol great soil group. They have few to many small rocks on the surface. They were developed in thick beds of indurated, stonelike caliche. The thickness of the solum varies within short distances.

The Kimbrough soils occupy higher elevations than the Potter and lower elevations than the Arvana and Brownfield. They are darker and have a smoother surface than the Potter soils. They also have a thicker vegetation, and most of the lime has been leached out of the surface layer. Stegall loam occupies the swales between areas of Kimbrough soils.

In small areas the wind often removes 2 to 3 inches of soil, and concretions and flat rock are exposed. The vegetation grows on small pedestals. In places on the steeper slopes, water erosion has caused rills and gullies.

The areas of Kimbrough soils cover several hundred acres.

Typical profile on a slope of about 1 percent (0.6 mile west and 0.15 mile north of northeast corner of section 391, 2 miles northwest of Plains, Tex.) :

A—0 to 8 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, subangular blocky structure; soft when dry, very friable when moist, and slightly sticky when wet; few fine fragments of calcium carbonate; common very fine roots and few medium roots; common rocks on the surface as much as 4 inches in diameter; noncalcareous.

Dr—8 inches +, indurated caliche; cannot be cut with auger, but some plates may be broken with a tile spade.

Range in characteristics.—The thickness of the A horizon ranges from 2 to 10 inches. The color ranges from reddish brown to brown, hue 5YR to 10YR, value 4 to 5, and chroma 3 to 4.

Lea series.—This series consists of shallow, moderately permeable, calcareous, dark grayish-brown loams. These soils are in the Chestnut great soil group.

The A horizon is dark grayish-brown loam, 6 to 10 inches thick. The AC horizon is pale-brown to grayish-brown clay loam, 8 to 14 inches thick. The depth to hard caliche ranges from 14 to 20 inches.

These soils occupy broad, flat plains at a slightly higher elevation (6 to 30 inches) than the associated Arch, Mansker, and Portales soils. The Mansker soils have unconsolidated parent material; the Arch are lighter colored than the Lea; and the Portales are deeper than the Lea and have unconsolidated, calcareous parent material at a depth of 26 to 30 inches.

The Lea soils are of minor extent. They occur mostly in the west-central part of the county in areas from 20 to 200 acres in size.

Typical profile on a slope of about 1 percent (0.6 mile west and 0.1 mile north of the southeast corner of section 369, 2 miles northwest of Plains, Tex., on U.S. Highway No. 380) :

A1—0 to 9 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, subangular blocky structure; slightly hard when dry, friable when moist, and sticky when wet; many fine and common very fine roots, tubes, and pores and few medium roots, tubes, and pores; weakly calcareous; clear boundary.

AC—9 to 16 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; weak, subangular blocky structure; slightly hard when dry, friable when moist, and sticky when wet; common very fine and fine roots, tubes, and pores and few medium roots, tubes, and pores; strongly calcareous; abrupt boundary.

D—16 inches +, indurated caliche.

Range in characteristics.—The depth to hard caliche ranges from 14 to 20 inches.

Mansker series.—This series consists of shallow, grayish-brown, moderately permeable soils. These soils are in the Calcisol great soil group. They were developed in strongly calcareous, fine to moderately coarse textured, unconsolidated sediment. These smooth and nearly level to gently sloping soils have slopes of 0 to 3 percent.

The A horizon ranges from loam to fine sandy loam in texture and from 6 to 12 inches in thickness. The Cca horizon is generally at a depth of 16 to 20 inches.

The Mansker are shallower and lighter colored than the Portales soils. They were developed on unconsolidated parent material, but Lea soils were developed over hard rock.

The Mansker soils are of moderate extent and occur throughout the northern half of the county. They are cultivated along with the deeper Portales soils.

Typical profile of Mansker fine sandy loam on a slope of about 1 percent (0.5 mile east of the northwest corner of section 427 on the town section of Plains, Tex., 0.5 mile north of the courthouse) :

A1—0 to 9 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; structureless; soft when dry, very friable when moist, and slightly sticky when wet; few very fine roots; strongly calcareous; clear boundary.

AC—9 to 17 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; compound weak, prismatic and weak, subangular blocky structure; slightly hard when dry, friable when moist, and sticky when wet; few fine roots, tubes, and pores; many worm casts and burrows; common very fine fragments of calcium carbonate; strongly calcareous; clear boundary.

Cca—17 to 26 inches, very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) when moist; slightly hard when dry, friable when moist, and sticky when wet; common fine and medium concretions of calcium carbonate; very strongly calcareous; clear boundary.

C—26 to 36 inches +, very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) when moist; consistence as in Cca horizon; very strongly calcareous.

Range in characteristics.—The color of the A horizon ranges from grayish brown to dark brown, hue 10YR, value 4 to 5, and chroma 2 to 3.

The color of the AC horizon ranges from pale brown to gray, hue 10YR, value 5 to 7, and chroma 2 to 3.

The depth to the Cca horizon ranges from 16 to 20 inches. The color ranges from very pale brown to white, hue 10YR, value 6 to 8, and chroma 1 to 3.

The color of the C horizon ranges from pale brown to white, hue 10YR, value 6 to 8, and chroma 1 to 3.

Portales series.—In this series are calcareous, grayish-brown, permeable loamy soils. These soils are in the Calcisol great soil group. They were developed in strongly calcareous old alluvium (old lakebed deposits). They have smooth slopes that range from 0 to 3 percent.

The A horizon ranges from 8 to 16 inches in thickness, from grayish brown to dark grayish brown in color, and from loam to fine sandy loam in texture.

The AC horizon is brown to light brownish-gray sandy clay loam, 8 to 16 inches thick.

The Cca horizon is 24 to 36 inches below the surface. It ranges from 6 to 12 inches in thickness and from pale brown to white in color. It is very strongly calcareous and has a clay loam texture.

The C horizon occurs at a depth of 30 to 40 inches and is a light brownish-gray to white clay loam.

These soils are associated with the Mansker, Zita, Amarillo, and Arch soils. They are deeper and darker colored than the Mansker soils. They are lighter colored than the Zita soils, which are noncalcareous to a depth of 10 to 20 inches. The Portales soils are normally shallower and not so red as the Amarillo soils, which are noncalcareous to a depth of 24 inches or more. They are deeper and darker colored than the Arch soils and contain less lime in the surface soil.

The Portales soils are fairly extensive; the largest areas are in the west-central part of the county.

Typical profile of Portales fine sandy loam on a slope of about 1 percent (0.3 mile south of the northwest corner of section 20, block K, 12 miles east of Plains, Tex., on U.S. Highway No. 380, then north 6 miles on Farm Road No. 1780):

Ap—0 to 13 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; structureless; soft when dry, very friable when moist, and slightly sticky when wet; common fine, roots, tubes, and pores and few medium roots, tubes, and pores; few insect casts and burrows; weakly calcareous; abrupt boundary.

AC—13 to 25 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) when moist; weak, subangular blocky structure; slightly hard when dry, firm when moist, and sticky when wet; common fine roots; common fine insect casts and burrows; strongly calcareous; clear boundary.

Cca—25 to 36 inches, white (10YR 8/2) clay loam, light gray (10YR 7/2) when moist; slightly hard when dry, firm when moist, and sticky when wet; soft, segregated pockets and few fine concretions of calcium carbonate; very strongly calcareous; gradual boundary.

C—36 to 50 inches +, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; hard when dry, firm when moist, and very sticky when wet; strongly calcareous.

Range in characteristics.—The A horizon ranges from 8 to 16 inches in thickness. The color ranges from grayish brown to dark grayish brown, hue 10YR, value 4 to 5, and chroma 2 to 3. The A horizon ranges from weakly to strongly calcareous. The thicker and strongly calcareous A horizons are usually in cultivated areas that have been plowed 14 to 18 inches deep.

The AC horizon ranges in color from brown to light brownish gray, hue 10YR, value 5 to 6, and chroma 2 to 3.

The depth to the Cca horizon ranges from 24 to 36 inches. The color ranges from pale brown to white, hue 10YR to 2.5Y, value 6 to 8, and chroma 2 to 3.

The C horizon ranges in color from light brownish gray to white, hue 10YR to 2.5Y, value 6 to 8, and chroma 1 to 3.

Potter series.—The soils of this series are calcareous, pale-brown to grayish-brown Lithosols. They are very shallow over cemented caliche. The parent material is caliche or a mixture of earth and caliche that contains more than 50 percent of calcium carbonate.

These soils occur as narrow bands on the steep slopes of ancient drains. They are usually associated with the higher lying Arvana, Mansker, and Amarillo soils.

The Potter soils are more calcareous and lighter colored and are over softer caliche than the Kimbrough. They are shallower and lighter colored than the Mansker soils.

Typical profile on a slope of about 12 percent (0.8 mile north and 0.5 mile east of southwest corner of section 425, 2.5 miles northwest of Plains, Tex.):

A—0 to 6 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; structureless; slightly sticky when wet, very friable when moist, and soft when dry; many rocks on the surface; many hard fragments of calcium carbonate; weakly calcareous; abrupt boundary.

D—6 inches +, soft caliche.

Randall series.—This series consists of poorly drained, gray to dark-gray clayey soils that occupy the floors of enclosed depressions or intermittent lakes. These lakes were probably formed by water that dissolved the underlying bedrock. The parent material contains alluvial silt and clay washed from surrounding, higher lying soils. These soils are in the Grumusol great soil group.

The A horizon is gray to very dark gray clay, 10 to 30 inches thick. The subsoil is dark-gray, slowly permeable, tough plastic clay.

In this county the typical Randall soil occupies the floors of a chain of six intermittent lakes that formed in a relict drain. The Randall soils have a slight gilgai relief, 6 to 8 inches deep and 2 to 3 feet across. After seasons of heavy rainfall, they may remain under water for short periods.

Areas of Randall soil are minor in extent, circular in shape, and rarely more than 4 acres in size.

Typical profile (0.5 mile west and 100 feet south of the northeast corner of section 391, 1 mile northwest of Plains, Tex.):

A—0 to 10 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; moderate, fine, blocky structure; very hard when dry, very firm when moist, and very sticky and plastic when wet; common medium roots and many fine roots; thin, patchy clay films on faces of the large peds; some sand particles on the faces of old cracks; noncalcareous; gradual boundary.

AC—10 to 34 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; moderate, medium, blocky structure; very hard when dry, very firm when moist, and very sticky and plastic when wet; well-defined horizontal cleavage at ¼- to ½-inch intervals; the clay films are more distinct on the horizon breakages; many very fine roots follow these horizontal planes; few medium roots and common fine roots; most roots follow the ped faces; sand particles as in AC horizon; few fine tubes; noncalcareous; gradual boundary.

C—34 to 76 inches +, grayish-brown (10YR 5/2) light clay, dark grayish brown (10YR 4/2) when moist; firm when moist and sticky and plastic when wet; very slightly calcareous.

Range in characteristics.—The A horizon ranges from 10 to 30 inches in thickness. The color ranges from gray to very dark gray, hue 10YR, value 3 to 5, and chroma of 1.

The subsoil is dark gray to very dark gray clay, hue 10YR, value 3 to 4, and chroma 1.

The parent material is a slightly calcareous to calcareous clay. Its color ranges from grayish brown to light brownish gray, hue 10YR, value 5 to 6, and chroma 1.

Springer series.—This series consists of moderately sandy Reddish Brown soils developed in eolian sandy sediments.

The A horizon is reddish-brown loamy fine sand. The B horizon is red to yellowish-red, noncalcareous loam to fine sandy loam. Indurated caliche occurs at a depth of 16 to 36 inches.

The Springer soils have a less clayey subsoil than the Brownfield or Amarillo soils.

Typical profile of Springer loamy fine sand on a slope of about 1 percent (0.2 mile north and 100 feet east of the southwest corner of section 218, 6 miles northwest of Plains on U.S. Highway No. 380, then 4 miles north on a dirt road):

A1—0 to 14 inches, reddish-brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) when moist; structureless; loose when dry, nearly loose when moist, and nonsticky when wet; common fine roots, tubes, and pores; slight organic stains in upper 2 inches; noncalcareous; clear boundary.

B21—14 to 24 inches, yellowish-red (5YR 5/8) fine sandy loam, yellowish red (5YR 4/8) when moist; compound moderate, coarse, prismatic and weak, subangular blocky structure; slightly hard when dry, very friable when moist, and nonsticky when wet; few fine roots, tubes, and pores; slight clay films on prism faces; few fine insect casts and burrows; noncalcareous; gradual boundary.

B22—24 to 32 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) when moist; massive to weak, subangular blocky structure; consistence as in B21 horizon; very few, very fine roots; noncalcareous.

D—32 inches +, hard caliche; made up of plates 2 to 6 inches long and 1 to 2 inches thick.

Range in characteristics.—The A horizon ranges from 8 to 16 inches in thickness. It ranges in color from reddish brown to brown, hue 5YR to 7.5YR, value 4 to 6, and chroma 4 to 6.

The B horizon ranges from 8 to 26 inches in thickness. It ranges in color from red to yellowish red, hue 2.5YR to 5YR, value 4 to 5, and chroma 4 to 6.

The D horizon occurs at a depth of 16 to 36 inches.

Spur series.—This series consists of grayish-brown, calcareous, moderately permeable Alluvial soils that have a calcareous, permeable subsoil. These soils occupy the floors of the ancient drainage channels of the headwaters of the Colorado River.

The A horizon ranges from strongly calcareous clay loam to fine sandy loam, 12 to 20 inches thick. The AC horizon is clay loam, 40 to 60 inches thick. The C horizon ranges from very strongly calcareous clay loam to sandy clay loam.

The principal associated soils at higher elevations are the Potter, which are Lithosols that occupy the steep slopes on the edge of the draws, and the Mansker, which are Calcisols that are higher in elevation and are shallower than the Spur soils.

The Spur soils are limited in extent. They occur only on the floors of the ancient drains that cross the district from the northwest to the southeast. The texture of the surface layer is sandier with distance to the southeast.

Typical profile on a slope of about 1 percent (0.4 mile south and 0.2 mile west of the northeast corner of section 426 on U.S. Highway No. 380, 0.5 mile northwest of Plains, Tex.):

A1—0 to 16 inches, very dark grayish-brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist, and very sticky when wet; many fine and common medium roots, tubes, and pores; common medium insect casts and burrows; strongly calcareous; gradual boundary.

AC—16 to 63 inches, light brownish gray (10YR 6/2), heavy clay loam, grayish brown (10YR 5/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist, and very sticky when wet; common very fine roots, tubes, and pores and few medium roots, tubes, and pores; common fine to medium insect casts and burrows; strongly calcareous; clear boundary.

C—63 to 78 inches, white (10YR 8/2) sandy clay loam, light gray (10YR 7/2) when moist; hard when dry, friable when moist, and sticky when wet; very strongly calcareous.

Range in characteristics.—The thickness of the A horizon ranges from 12 to 25 inches. The color ranges from brown to very dark grayish brown, hue 10YR, value 3 to 5, and chroma 2 to 4.

The thickness of the AC horizon ranges from 20 to 50 inches or more. The color ranges from light brown to brown, hue 7.5YR to 10YR, value 4 to 6, and chroma 2 to 4.

The depth to the C horizon ranges from 24 to 64 inches or more. The color ranges from white to grayish brown, hue 10YR, value 5 to 8, and chroma 2 to 3.

Stegall series.—This series consists of brown, noncalcareous, slowly permeable soils. These soils are in the Chestnut great soil group. They are shallow to moderately deep and are underlain by hard caliche. They are level and smooth and occupy the swales between larger areas of Kimbrough soils. They form drainageways for the very shallow Kimbrough soils.

The A horizon is noncalcareous loam. The subsoil is sandy clay loam to heavy clay loam. The structure ranges from moderate to medium, subangular blocky to moderate, fine, irregular blocky.

The Stegall soils are less permeable and are less red than the Arvana and are deeper than the Kimbrough, which are very shallow Lithosols.

Typical profile (0.15 mile south and 0.1 mile east of the southwest corner of section 391, 1.5 miles northwest of Plains, Tex., and north of U.S. Highway No. 380):

A1—0 to 6 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) when moist; moderate, fine, subangular blocky structure; slightly hard when dry, friable when moist, and sticky when wet; common fine roots and few medium roots; few very fine tubes and pores; few medium insect burrows; noncalcareous; clear boundary.

B2—6 to 18 inches, dark grayish-brown (10YR 4/2), heavy clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, blocky structure that breaks into moderate, fine, subangular blocky structure; very hard when dry, firm when moist, and very sticky and slightly plastic when wet; many very fine roots on faces of the peds; few fine roots throughout; faint clay skins; common very fine tubes and pores; noncalcareous.

D—18 inches +, indurated caliche; fragments are 6 to 8 inches across and are irregular in shape.

Range in characteristics.—The entire profile ranges in color from brown to dark grayish brown, hue 7.5YR to 10YR, value 4 to 5, and chroma 2 to 3. The depth to hard caliche ranges from 12 to 36 inches.

Tivoli series.—The soils of the Tivoli series are Regosols. They consist of deep, light-colored loose sand. Most of the fine sediments have been sorted out and blown away, so that the soils now consist of deep, fine dune sand. The siliceous sandy material resists breakdown into finer materials and, as a result, it has practically no profile de-

velopment. Because the decaying plants furnish a very small amount of organic matter, there is only a slight darkening of the upper 8 to 10 inches.

The Tivoli soils form the sandhills—a belt, 4 to 6 miles wide along the northern edge of the county. They consist mostly of dunes that have short, choppy slopes as steep as 20 percent.

In this county those soils are associated with the lower lying, interdune areas of less hummocky Brownfield soils and are mapped as Brownfield-Tivoli fine sands.

Typical profile (0.15 mile south of northeast corner of section 35):

- A1—0 to 6 inches, light brownish-gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) when moist; structureless; loose when moist and dry and nonsticky when wet; few medium and large roots; noncalcareous; gradual boundary.
- C1—6 to 40 inches, very pale brown (10YR 7/4) fine sand, light yellowish brown (10YR 6/4) when moist; structureless; consistence the same as in A1 horizon; very few large roots; noncalcareous; diffuse boundary.
- C2—40 to 96 inches, pink (7.5YR 7/4) fine sand, light brown (7.5YR 6/4) when moist; structureless; consistence the same as in A1 horizon; noncalcareous; clear boundary.
- D—96 to 106 inches +, light yellowish-brown (10YR 6/4), light sandy clay loam, yellowish brown (10YR 5/4) when moist; hard when dry, very friable when moist, and slightly sticky when wet; noncalcareous.

Range in characteristics.—The A1 horizon ranges from 6 to 10 inches in thickness. It ranges in color from light brownish gray to brown, hue 10YR, value 5 to 6, and chroma 2 to 3.

The underlying sandy material ranges from pink to yellow, hue 7.5 YR and 10YR, value 7, and chroma 4 to 6.

These soils are in many places underlain at a depth of 60 to 100 inches by noncalcareous to very strongly calcareous fine sandy loam to sandy clay loam. Some bands of reddish-yellow fine sandy loam, one-half inch thick, occur at a depth below 48 inches.

Zita series.—The Zita series consists of brown to dark grayish-brown, moderately deep, moderately permeable soils with smooth and nearly level slopes. These soils are in the Chestnut great soil group.

The A horizon is loam to fine sandy loam, 8 to 20 inches thick. The AC horizon is grayish-brown, calcareous sandy loam, 8 to 16 inches thick. The Cca horizon is sandy clay loam to clay loam and is very strongly calcareous.

The parent material occurs at a depth of 26 to 36 inches. It ranges from strongly calcareous sandy clay loam to clay loam.

The Zita soils have a calcareous subsoil, are less red, and have a shallower Cca horizon than the Amarillo soils. The Portales soils are calcareous in the surface layer but the Zita soils are not.

The Zita soils are minor in extent; they occur in areas of 20 to 40 acres throughout the county. These soils are cultivated with the surrounding Amarillo and Portales soils.

Typical profile (0.4 mile south of the northeast corner of section 605, about 6 miles southwest of Plains, Tex., on Farm Road No. 1622):

- A1p—0 to 18 inches, dark-brown (10YR 4/3) fine sandy loam, very dark brown (10YR 3/3) when moist; structureless; soft when dry, very friable when moist, and slightly sticky when wet; many fine roots, tubes, and pores; common insect and worm casts and burrows; noncalcareous; abrupt boundary.
- AC—18 to 33 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) when moist; compound moderate, coarse, prismatic and weak, subangular blocky structure; slightly hard when dry, friable when moist, and sticky when wet; many insect and worm casts and burrows; common fine roots, tubes, and pores; strongly calcareous; clear boundary.
- Cca—33 to 40 inches, white (10YR 8/2) sandy clay loam, light gray (10YR 7/2) when moist; common fine concretions of calcium carbonate; very strongly calcareous.
- C—40 to 60 inches +, very pale brown (10YR 7/3) clay loam, very pale brown (10YR 6/3) when moist; few very fine concretions of calcium carbonate; strongly calcareous.

Range in characteristics.—The A horizon ranges from 8 to 20 inches in thickness and from loam to fine sandy loam in texture. The color ranges from grayish brown to dark brown, hue 10YR, value 3 to 5, and chroma 2 to 3. The higher values are for A horizons that have been plowed and have been mixed with some of the soil in the horizon below.

The AC horizon ranges from 8 to 16 inches in thickness and from dark grayish brown to pale brown in color, hue 10YR, value 4 to 6, and chroma 2 to 3.

The depth of the Cca horizon from the surface ranges from 24 to 38 inches. The thickness of this horizon ranges from 8 to 16 inches. The color ranges from white to pale brown, hue 10YR, value 6 to 7, and chroma 2 to 3. In places hues of 7.5YR occur in low flood plains where the Zita and Amarillo soils are mixed. Here the color ranges from pinkish gray to pink, hue 7.5YR, value 7 to 8, and chroma 2 to 4.

The C horizon at a depth of 32 to 60 inches ranges in color from pinkish white to very pale brown, hue 7.5YR to 10YR, value 7 to 8, and chroma 2 to 4.

In places indurated caliche is 32 to 60 inches below the surface.

General Nature of the County

Some of the general characteristics of the county are discussed in this section. These include agriculture, wildlife, geology, and climate.

Agriculture

Before 1874 the Comanche Indians lived in the area now known as Yoakum County. Thousands of buffalo ranged the vast, treeless plains. Quail and antelope were also plentiful.

Yoakum County was created from Bexar Territory in 1876. It was attached first to Martin County and then to Terry County for judicial purposes. The county was organized in 1907 and was named for Henderson Yoakum, a pioneer author, jurist, and soldier in the Mexican War. When the county was surveyed, it was divided mostly into sections, or square miles. Only a few irregular areas were surveyed. Most of the county was surveyed in the John D. Gibson Survey (*6*).

Settlers were first attracted to the county by the abundance of native grasses suitable for grazing. They established ranches near the sources of water. Before wells were dug and windmills constructed, the use of rangeland was controlled by those having water rights to the few, natural springs. In the early days stock farming and ranching were the main occupations.

Later farmers were attracted by the fertile soil. Good yields of cotton, grain sorghum, and other crops encouraged farming in years when rainfall was favorable. The development of irrigation wells in the mid 1940's further increased crop production.

Since about 1950 irrigated farming has become important, and many wells have been dug and productive farms have been developed. According to the 1954 Federal census, there were only 4,191 acres under irrigation in the county in 1949, and about 60 irrigation wells. At the time of the survey, there were about 450 irrigation wells.

Enough underground water for use of livestock and for home use can be obtained in most of the county.

Farming in Yoakum County consists mainly of growing cotton and grain sorghum for market and grass for pasture. According to the Federal census, in 1959 there were 275 farms in the county, totaling 465,022 acres. Of this total, 32,716 acres were irrigated. The acreage of irrigated cropland harvested was 31,482, and that of other irrigated land was 1,234. Of the 32,716 acres under irrigation, 26,012 acres were irrigated by sprinklers. Cropland harvested totaled 145,244 acres. Land in pasture totaled 298,096 acres, of which 1,828 acres were improved pasture. The land in cotton totaled 33,119 acres; and that in sorghum for all purposes totaled 105,761 acres.

In 1959 there were 8,801 cattle and calves (141 of which were dairy cows); 9,137 chickens, 4 months old or over; and 1,524 hogs and pigs.

The first productive oil well was drilled in 1936. The original wells have remained productive, and new wells are being added. At the time of the survey, there were approximately 1,200 oil wells in the county that produced about 40,000 barrels per day.

Wildlife

Bobwhite, blue quail, and mourning doves are the principal game birds in Yoakum County. There are a few prairie chickens, which are protected by a year-round closed season. Crows, sandhill cranes, and curlews are also found in the county. There are many varieties of migratory birds.

Antelopes are now almost extinct and are protected by a closed season. They are still seen occasionally in the northern sandhills of the county in the Brownfield-Tivoli association.

The county has large numbers of cottontail rabbits and jackrabbits. Sometimes control practices are needed to prevent these rodents from excessively damaging small grains.

A few small prairie-dog towns remain in remote areas of Amarillo fine sandy loam or Portales fine sandy loam. These hardy little rodents have survived the attempts of farmers and ranchers to eradicate them. Their burrows are hazardous to livestock.

Another rodent in the county is the common ground squirrel. It is increasing in number and may eventually become a pest. There are many field mice and also a few skunks and porcupines.

All of the snakes in the county are harmless except the sand rattlers. These are mostly in pastures or rangeland.

All species of wildlife suffer from lack of food and cover during critical periods in winter and early in spring. Although great quantities of feed are raised in Yoakum County, little remains on the land in winter. Early preparation of the soil not only increases the hazard of wind erosion but also destroys essential food and cover. Thus, game is subject to starvation in severe weather. Many acres of once-tilled land, however, have been planted permanently to tall forage. These areas provide feed and cover for wildlife. Both quail and doves have increased in number in recent years, mainly because of large amounts of rainfall.

Geology

The outstanding geologic event in the history of Yoakum County was the deposition of the Ogallala formation. This formation is the main source of irrigation water in the county. It was formed from materials deposited more than a million years ago, during the early Pliocene epoch. To understand how this underground formation developed, it is necessary to review the geologic history of the area.

About 180 million years ago (shortly before the uplift of the Appalachian Mountains), a shallow sea covered the area that is now western Texas. Marine sediments that were deposited during this period formed the Permian Red Beds. While the Appalachian Mountains were being formed, the High Plains rose above the level of the sea. Streams that flowed over the exposed Permian rocks eroded fine-textured materials and redeposited them along the flood plains. These materials formed the Triassic Red Beds, or the impervious stratum that underlies the Ogallala formation.

During the Cretaceous period, a shallow arm of the sea again partly covered the High Plains. Sand, clay, and limestone were deposited over most of the area.

The formation of the Rocky Mountains was the next significant development. Swift streams from the mountains cut valleys and canyons through the Cretaceous rock formed from the deposits of the Cretaceous period and into the underlying Triassic Red Beds. Most of the Cretaceous material that had been deposited on the High Plains was washed away. The Cretaceous formation does not come to the surface anywhere in Yoakum County.

When the Rocky Mountains reached their maximum height, they began to erode. Coarse, gravelly material was carried great distances by the swift streams. As the mountains were eroded, the streams became less swift and began to deposit gravel, sand, and silt near their sources. These deposits formed alluvial fans of gravelly, coarse material along the foot slopes of the mountains. The finer materials were transported and spread farther to the east. The Ogallala formation developed from these deposits of outwash more than a million years ago. This outwash was deposited just before the beginning of the ice age. The glaciers did not move as far south as Texas, but during the ice age a much moister climate prevailed in this area. Because of an increase in precipitation, streams formed and flowed across the Ogallala formation. The draws crossing Yoakum County are probably the remains of these streams.

The source of the underground water in Yoakum County is the saturated beds of sand and gravel in the lower part of the Ogallala formation and not an underground river or lake. The Triassic Red Beds underneath the Ogallala formation are fairly impervious, so it is not

likely that water could be obtained from any of the lower strata. During the development of the Ogallala formation in a period of nearly a million years, water from the Rocky Mountains was stored in its water-bearing stratum. The Pecos River on the west and the Canadian River on the north cut off the Ogallala formation from the mountains and blocked its source of water. At present rain or snow that falls on the High Plains probably is the only source of water to replenish the underground supply.

The Ogallala formation of water-bearing sand is between 100 and 300 feet thick. Saturated sand is generally thin in the northeastern one-fourth of the county. The average depth to water in Yoakum County is 150 feet.

The water tables slopes gently to the southeast, and the water moves very slowly. The natural rate of flow is probably not more than 1 or 2 feet a day. Before wells were drilled for irrigation, the water was discharged mainly by springs along the caprock at about the same rate it was replenished. At present water is being pumped for irrigation faster than it is being restored.

The amount of water available varies considerably in places because of variations in the thickness of the water-producing stratum and the depth to the Red Beds. Apparently, the Red Beds are undulating, and in places they rise nearly to the static water table, or above it. Certain areas of Yoakum County have no irrigation water, probably for this reason.

The materials from which the soils of the county developed were deposited during the Pliocene epoch and were then reworked in the Pleistocene epoch. The wind did most of this reworking during the Illinoian age. This age was fairly dry, and the wind shifted and sorted the surface materials. During this age, Yoakum County was probably a prairie with a scant supply of water.

As the glaciers moved southward into the United States, the climate of Texas became much wetter. During this time, Yoakum County probably consisted of humid prairies and wooded areas along streams. When the glaciers receded, the climate became more arid, and the soils and vegetation developed as they now are.

Climate [4]

Yoakum County has the warm-temperate, continental climate that is characteristic of the southern High Plains of Texas. Because of the combination of low annual precipitation, high wind velocities, high summer temperatures, and low humidity, agriculture has many risks. The climate is characterized by rapid changes and extremes in both the temperature and amount of rainfall. Hot summer days are followed by cool nights. Winter temperatures are generally moderate, but there are frequent, sudden cold spells.

More than 80 percent of the average annual rainfall occurs during the warmer half of the year, May through October. Then warm, moist air flows northward from the Gulf of Mexico. It is therefore difficult to grow enough cover crops in winter to control wind erosion. Crops that leave enough stubble must be grown in the months of high rainfall.

Figure 19 shows the annual rainfall and the average monthly distribution of rainfall for the period 1948 through 1960. The average annual precipitation, based on this period, is 15.91 inches. Thunderstorms occur more frequently in the afternoon and evening and produce moderate to heavy rainfall in short periods. These heavy thunderstorms cause excessive runoff and rapid erosion of sloping, unprotected areas of cultivated land.

Rains, caused most frequently by thunderstorms, produce monthly and annual amounts of rainfall that are extremely variable. The monthly extremes ranged from zero to 10.69 inches. Annual extremes ranged from 7.86 inches in 1927 to 26.59 inches in 1926.

As shown in figure 19, the average monthly rainfall for May is 2.30 inches. This amount is ideal for planting cotton. Furthermore, the temperature is mild in May. If cotton is planted after the soil temperature has reached 60° F. at sunrise for 10 consecutive days, the best stands are obtained. Usually this 10-day period starts somewhere between May 5 and May 10.

Much of the precipitation is not effective. The average rainfall is not effective in July and August, because most of it is in local thunderstorms. In these months the humidity is low and the temperature and rate of evaporation are high. Rainfall is more effective in September and October when it is cooler.

Snow falls occasionally in the winter, but it is generally light and remains on the ground only a short time.

Temperatures, like rainfall, range widely. During the colder months of the year, November through March, surges of cold air from the north are frequent. These cold fronts, called northers, are usually of rather short duration. The fast-moving cold fronts are followed by rapid warming. Consequently, frequent and pronounced changes in temperature occur from day to day and sometimes from hour to hour. A drop of 30° in 2 hours is not unusual.

Summer days are warm, but low humidity and good circulation of wind lessen the effect of the heat on personal comfort. Because of the high elevation (3,500 feet at Plains) and dry air, summer nights are cool and comfortable; low temperatures are in the 60's.

Because of low-pressure centers that originate on the High Plains just east of the Rocky Mountains, the strongest, continuous winds are in February, March, and April. Sustained wind velocities of 35 miles per hour for 24 hours are common. These winds often produce duststorms that severely damage unprotected, cultivated land. The winds are strongest during severe thunderstorms of late spring and early summer, but they are of short duration. These windstorms injure small crops, and in some years, farmers have to replant them two or three times. In all seasons the prevailing wind is generally southerly; it varies between southeast and southwest.

The humidity is relatively low, compared to that in sections of central and east Texas. The highest humidity occurs in the early morning hours and generally averages between 65 and 75 percent. The lowest humidity occurs in the warmest part of the afternoon and generally averages between 30 and 40 percent.

Damaging hailstorms may occur any time from spring planting to fall harvest. These hailstones are associated with severe thunderstorms late in spring and early in summer.

Freeze data have been estimated for Plains, Tex., from isopleths of late spring and early fall low temperatures

[4] By ROBERT B. ORTON, State climatologist, Weather Bureau, U.S. Department of Commerce.

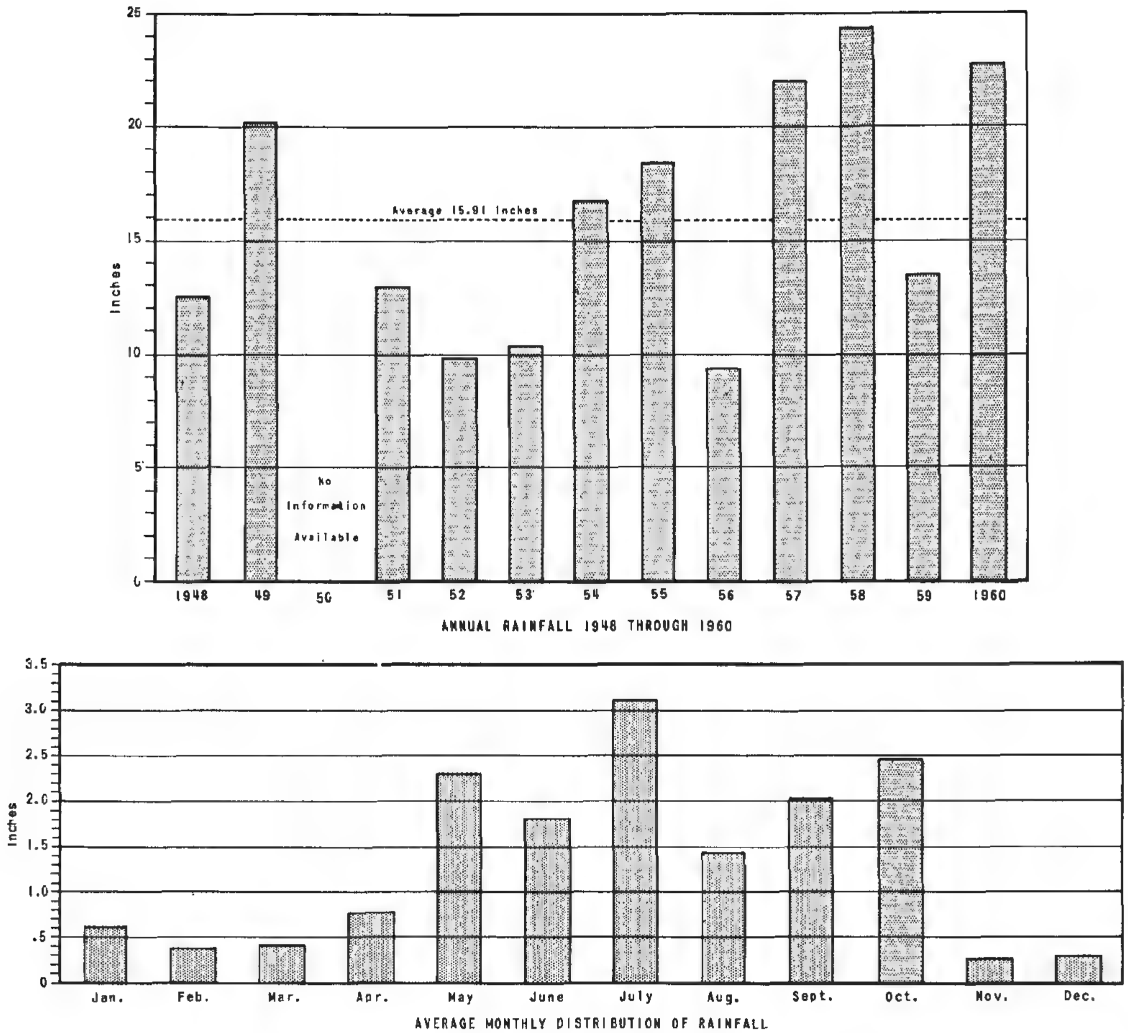

***Figure 19.*—Rainfall data, Plains, Tex., 1948 through 1960.**

(*3*). April 13 is the average date of the last freezing temperature in spring, and November 1 is the average date of the first freezing temperature in fall. A freezing temperature has 1 chance in 5 of occurring after April 25 or before October 23, and 1 chance in 20 of occurring after May 3 or before October 19.

Freeze data have also been estimated for Seminole, Gaines County, Tex., according to U.S. Weather Bureau records at this station. April 6 is the average date of the last freezing temperature in spring, and November 1 is the average date of the first freezing temperature in fall.

The growing season is short, as compared with that of central or south Texas but, on the average, is about 3 weeks longer than in parts of the northern High Plains. The average frost-free period is about 200 days. This period covers the number of days between the last occurrence of 32° F. in spring and the first occurrence of this temperature in fall. The average number of days between the last occurrence of 28° F. in spring and the first occurrence of this temperature in fall is about 220 days.

Table 5 shows the temperature and precipitation for Seminole, Gaines County, Tex., based on records of the United States Weather Bureau Station. The average annual precipitation at this station is 16.37 inches as compared to the 15.91 inches shown in figure 19 for Plains, Tex.

Sunshine occurs during much of the year; most of the infrequent cloudy weather is in winter and early in spring. As would be expected in this area, evaporation is high. The average annual evaporation from Weather Bureau pans is approximately 105 inches. Of this amount, approximately 66 percent evaporates during the period from May through October. The average annual lake evaporation is somewhat less (approximately 71 inches per year).

Except for the relatively small area of irrigated land, the agricultural economy of the county largely depends on rainfall. Lush, abundant crops (mainly cotton and grain sorghum) and good range grass for livestock are produced in years that have better than normal rainfall. In contrast, years of drought seriously affect the agricultural economy of the county. If good rains occur in spring and summer, the cattle range is good, even though the rainfall is below normal for the rest of the year.

Yoakum County is a marginal area for dryland farming. Most of the dryland farming is practiced in the northwestern part of the county. Little or no dryland

farming is now practiced in the extreme southwestern part of the county, where annual precipitation is lower.

TABLE 5.—*Temperature and precipitation at Seminole, Gaines County, Tex.*

[Elevation, 3,275 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1934)	Wettest year (1941)	Average snowfall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
January	42.1	82	−1	0.47	0.10	0.60	1.7
February	46.5	86	−23	.64	(3)	.65	1.9
March	52.3	91	8	.63	1.28	3.65	1.6
April	61.4	99	21	1.04	.52	2.51	.5
May	69.1	105	31	2.21	.24	10.58	(3)
June	77.6	109	38	2.00	.05	5.61	0
July	79.6	112	50	1.93	.31	2.43	(3)
August	78.7	109	52	2.06	2.86	1.13	0
September	72.6	106	34	2.08	.52	3.41	0
October	62.6	98	25	1.91	.58	5.88	(3)
November	50.6	89	7	.64	.10	.74	.1
December	43.5	83	0	.76	.01	.44	1.8
Year	61.4	112	−23	16.37	6.57	37.63	7.6

[1] Average temperature based on a 31-year record, through 1955; highest and lowest temperatures on a 23-year record, through 1952.
[2] Average precipitation based on a 32-year record, through 1955; wettest and driest years based on a 29-year record, in the period 1923–1955; snowfall based on a 23-year record, through 1952.
[3] Trace.

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Glossary

Alkaline soil. Generally, a soil that is alkaline throughout most or all of the parts of it occupied by plant roots, although the term is commonly applied to only a specific layer or horizon of a soil. Precisely, any soil horizon having a pH value greater than 7.0; practically, a soil having a pH above 7.3.

Alluvium. Fine material, such as sand, silt, or clay, that has been deposited on land by streams.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Chlorosis. A condition in plants resulting from the failure of chlorophyll (the green coloring matter) to develop, usually because of deficiency of an essential nutrient. Leaves of chlorotic plants range from light green through yellow to almost white.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay skin. A thin coating of clay on the surface of a soil aggregate. Synonyms: Clay coat, clay film.

Concretions. Hard grains, pellets, or nodules of various sizes, shapes, and colors, consisting of concentrations of compounds that cement the soil grains together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent; will not hold together in a mass.

Friable.—When moist, crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Nonsticky.—When wet, practically no soil material adheres to thumb or finger after release of pressure.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a wire when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material; tends to stretch somewhat and pull apart, rather than pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Indurated.—Very strongly cemented. In Yoakum County indurated refers to rocklike caliche.

Eolian (aeolian) soil material. Soil parent material accumulated through wind action; commonly refers to sandy material in dunes.

Munsell notation. A system of designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, value of 6, and a chroma of 4.

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

pH. A numerical means for designating relatively weak acidity and alkalinity, as in soils and other biological systems. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Phase, soil. A subdivision of a soil type, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects management.

Playas. Flat, generally dry, undrained basins that contain water for periods following rains.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the profile.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate, and living matter acting upon parent material, as conditioned by relief over periods of time.

Solum (pl. sola). The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying parent material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Surface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon and part of B horizon; has no depth limit.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil (see also clay, sand, and silt). The basic textural classes, in order of increasing proportions of fine particles are as follows: Sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES

[See table 1, p. 7, for approximate acreage and proportionate extent of the soils, and table 2, p. 26, for estimated yields per acre of cotton and grain sorghum under two levels of management]

Map symbol	*Mapping unit*	*Page*	*Capability unit* *Dryland*	*Page*	*Irrigated*	*Page*	*Range site* *Name*	*Page*
Aa	Arch loam, thin surface	8	IVes-1	21	IIIes-1	25	High Lime	29
Ac	Arch complex	8	IVes-1	21	IIIes-1	25	High Lime	29
AfA	Amarillo fine sandy loam, 0 to 1 percent slopes.	7	IIIe-1	20	IIe-4	24	Mixed Land	29
AfB	Amarillo fine sandy loam, 1 to 3 percent slopes.	8	IIIe-1	20	IIIe-2	24	Mixed Land	29
AmB	Amarillo loamy fine sand, 0 to 3 percent slopes.	7	IVe-1	20	IIIe-1	24	Sandy Land	28
AnB	Amarillo loamy fine sand, thin solum, 0 to 3 percent slopes.	7	IVe-1	20	IIIe-1	24	Sandy Land	28
AvA	Arvana fine sandy loam, 0 to 1 percent slopes.	8	IIIe-1	20	IIe-4	24	Mixed Land	29
AvB	Arvana fine sandy loam, 1 to 3 percent slopes.	9	IIIe-1	20	IIIe-2	24	Mixed Land	29
AwA	Arvana fine sandy loam, shallow, 0 to 1 percent slopes.	9	IVe 3	21	IIIe 4	25	Mixed Land	29
Be	Berthoud-Potter complex	9	VIs-1	22	(1)	--	Shallow Land	29
Br	Brownfield fine sand, thick surface	10	VIe 1	22	IVe 1	26	Deep Sand	28
Bs	Brownfield fine sand, thin surface	10	IVe-2	21	IIIe-5	25	Sandy Land	28
Bt3	Brownfield soils, severely eroded	10	VIe-1	22	(1)	--	Deep Sand	28
Bv	Brownfield-Tivoli fine sands	10	VIIe-1	22	(1)	--	Deep Sand	28
DrB	Drake soils, 1 to 3 percent slopes	10	IVes-1	21	IIIes-1	25	High Lime	29
Gf	Gomez fine sand	11	VIe-3	22	IVe-1	26	Sandy Land	28
Gl	Gomez loamy fine sand	11	IVe-1	20	IIIe 1	24	Sandy Plains	29
Km	Kimbrough soils	11	VIIs-1	22	(1)	--	Shallow Land	29
Ks	Kimbrough-Stegall complex	11	VIIs-1	22	(1)	--	Shallow Land	29
LeA	Lea loam, shallow, 0 to 1 percent slopes	11	IVe-4	21	IIIe-4	25	Mixed Plains	29
MfA	Mansker fine sandy loam, 0 to 1 percent slopes.	12	IVe-3	21	IIIe-4	25	Mixed Plains	29
MfB	Mansker fine sandy loam, 1 to 3 percent slopes.	12	IVe-3	21	IIIe-4	25	Mixed Plains	29
MkA	Mansker loam, 0 to 1 percent slopes	12	IVe-4	21	IIIe-4	25	Mixed Plains	29
PfA	Portales fine sandy loam, 0 to 1 percent slopes.	12	IIIe-2	20	IIe-5	24	Mixed Plains	29
PfB	Portales fine sandy loam, 1 to 3 percent slopes.	12	IIIe 2	20	IIIe-3	25	Mixed Plains	29
PmA	Portales loam, 0 to 1 percent slopes	12	IIIce-2	20	IIe-2	23	Mixed Plains	29
Rc	Randall clay	12	VIw 1	22	(1)	--	Deep Hardland	29
Sb	Springer and Brownfield soils, moderately shallow.	13	IVe-2	21	IIIe-5	25	Sandy Land	28
Sg	Springer and Brownfield soils, shallow	13	VIe 2	22	(1)	--	Sandy Land	28
Sp	Spur and Bippus soils	13	IIIe-1	20	IIe-4	24	Bottom Land	30
StA	Stegall loam, 0 to 1 percent slopes	13	IIIce-1	20	IIe-1	23	Deep Hardland	29
SuA	Stegall loam, shallow, 0 to 1 percent slopes	13	IVe 4	21	IIIe 4	25	Shallow Land	29
Tx	Tivoli-Potter complex	14	VIIe-2	22	(1)	--	Sandy Land	28
ZfA	Zita fine sandy loam, 0 to 1 percent slopes	14	IIIe-1	20	IIe-4	24	Mixed Land	29
ZmA	Zita loam, 0 to 1 percent slopes	14	IIIce-1	20	IIe-3	24	Deep Hardland	29

[1] Not suitable for irrigation.

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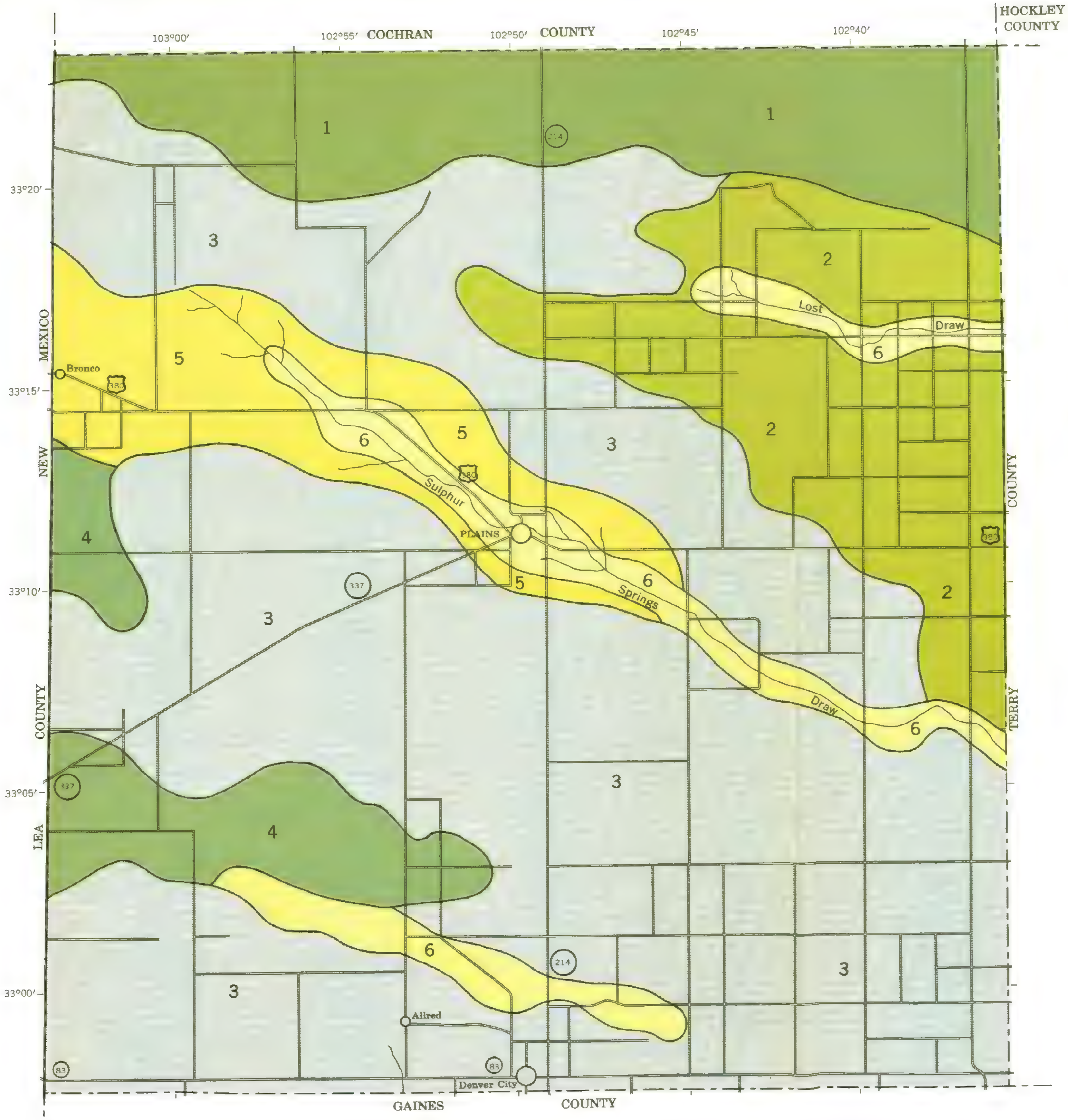
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
YOAKUM COUNTY, TEXAS

SOIL ASSOCIATIONS

1 Brownfield-Tivoli association: Deep, undulating sandy soils
2 Amarillo association: Deep sandy and loamy soils
3 Brownfield-Amarillo association: Deep sandy soils
4 Amarillo-Arvana association: Deep and moderately deep loamy soils
5 Portales-Arch association: Deep and shallow, calcareous loamy soils
6 Spur-Potter association: Deep and very shallow loamy soils

May 1963



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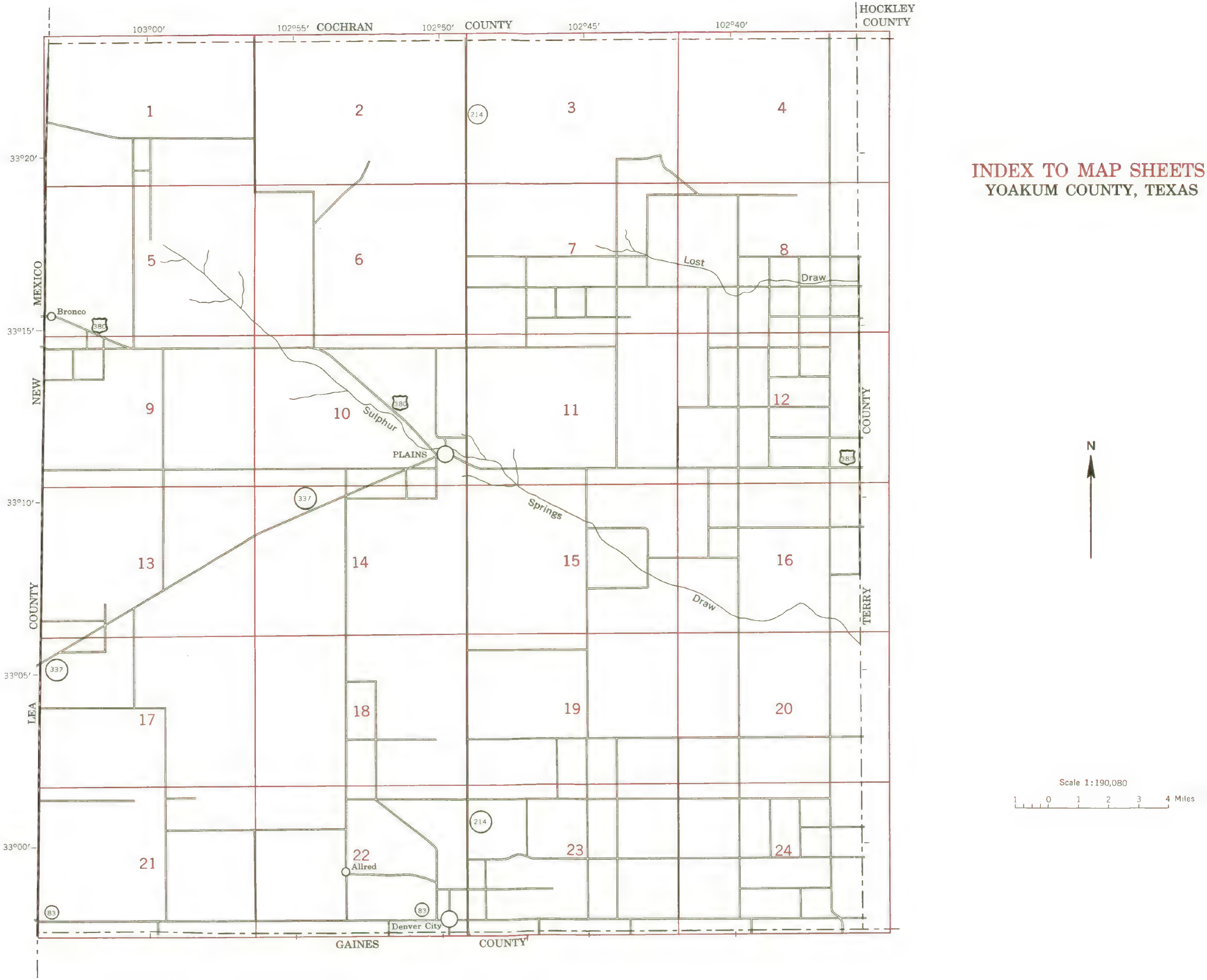
YOAKUM COUNTY, TEXAS



SOIL LEGEND

The first capital letter is the initial one of the soil series name. A second capital letter, A, or B shows the slope. Most symbols without a slope letter are those of nearly level soils, such as Randall clay, but some are for soils that have a considerable range of slope, such as the Berthoud-Potter complex. (W) following the soil name indicates that signs of erosion, especially of local shifting of soil by wind, are evident in some places, but the degree of erosion cannot be estimated reliably.

SYMBOL	NAME
Aa	Arch loam, thin surface
Ac	Arch complex
AfA	Amarillo fine sandy loam, 0 to 1 percent slopes
AfB	Amarillo fine sandy loam, 1 to 3 percent slopes
AmB	Amarillo loamy fine sand, 0 to 3 percent slopes (W)
AnB	Amarillo loamy fine sand, thin solum, 0 to 3 percent slopes (W)
AvA	Arvana fine sandy loam, 0 to 1 percent slopes
AvB	Arvana fine sandy loam, 1 to 3 percent slopes
AwA	Arvana fine sandy loam, shallow, 0 to 1 percent slopes
Be	Berthoud-Potter complex (W)
Br	Brownfield fine sand, thick surface (W)
Bs	Brownfield fine sand, thin surface (W)
Bt3	Brownfield soils, severely eroded
Bv	Brownfield-Tivoli fine sands (W)
DrB	Drake soils, 1 to 3 percent slopes (W)
Gf	Gomez fine sand (W)
Gl	Gomez loamy fine sand (W)
Km	Kimbrough soils
Ks	Kimbrough-Stegall complex
LeA	Lea loam, shallow, 0 to 1 percent slopes
MfA	Mansker fine sandy loam, 0 to 1 percent slopes (W)
MfB	Mansker fine sandy loam, 1 to 3 percent slopes (W)
MkA	Mansker loam, 0 to 1 percent slopes
PfA	Portales fine sandy loam, 0 to 1 percent slopes
PfB	Portales fine sandy loam, 1 to 3 percent slopes
PmA	Portales loam, 0 to 1 percent slopes
Rc	Randall clay
Sb	Springer and Brownfield soils, moderately shallow (W)
Sg	Springer and Brownfield soils, shallow (W)
Sp	Spur and Bippus soils
StA	Stegall loam, 0 to 1 percent slopes
SuA	Stegall loam, shallow, 0 to 1 percent slopes
Tx	Tivoli-Potter complex (W)
ZfA	Zita fine sandy loam, 0 to 1 percent slopes
ZmA	Zita loam, 0 to 1 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Levees

Tanks

Cotton gin

Windmills

BOUNDARIES

- National or state
- County
- Township, U. S.
- Section line, corner
- Reservation
- Land grant

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches (CANAL, DITCH)

Lakes and ponds
- Perennial
- Intermittent

Wells (flowing)

Springs

Marsh

Wet spot

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies

Soil map constructed 1963 by Cartographic Division, Soil Conservation Service, USDA, from 1957 aerial photographs. Controlled mosaic based on Texas plane coordinate system, north central zone, Lambert conformal conic projection. 1927 North American datum.

1

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

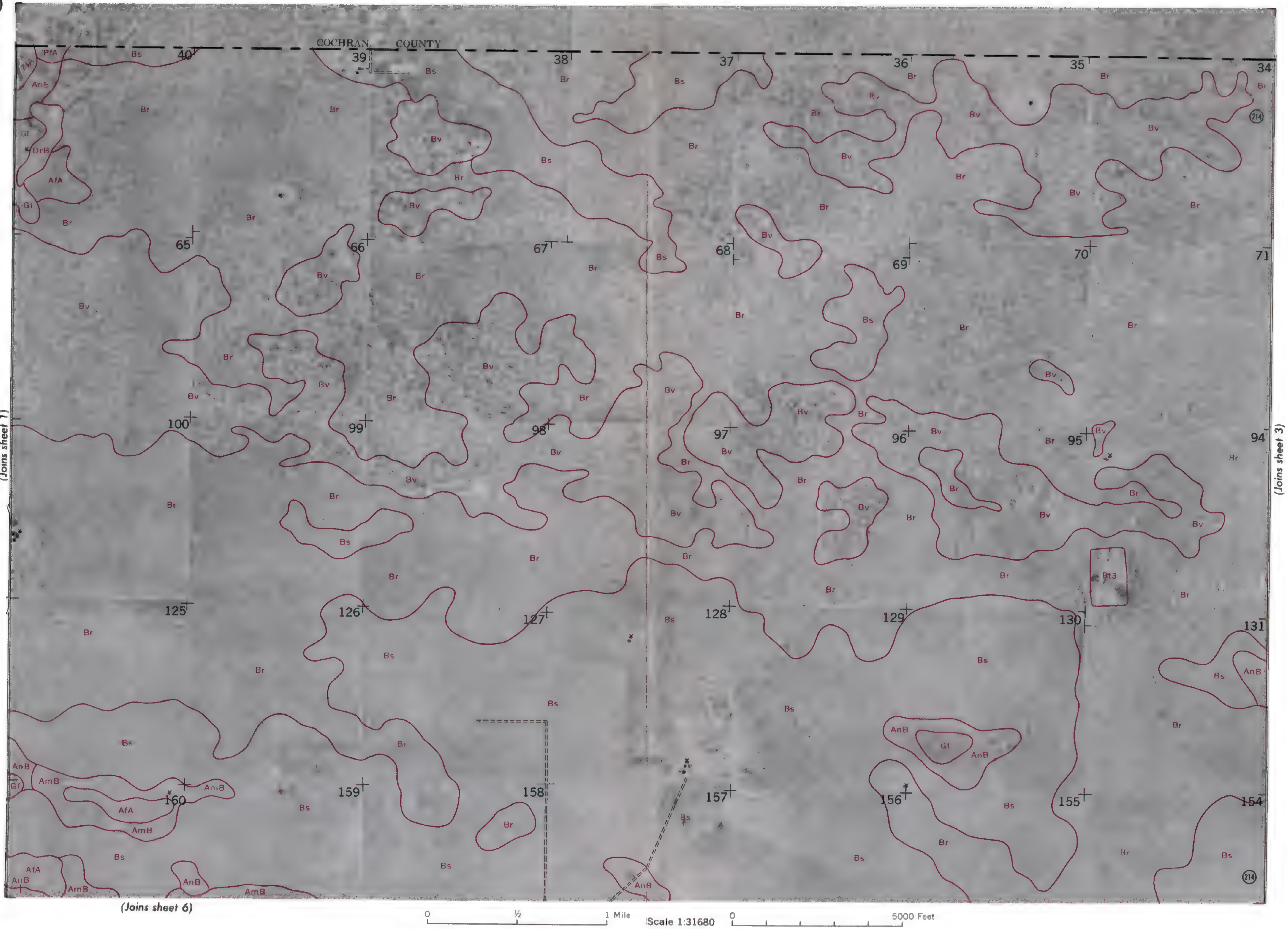
Land division corners and numbers shown on this map are indefinite.

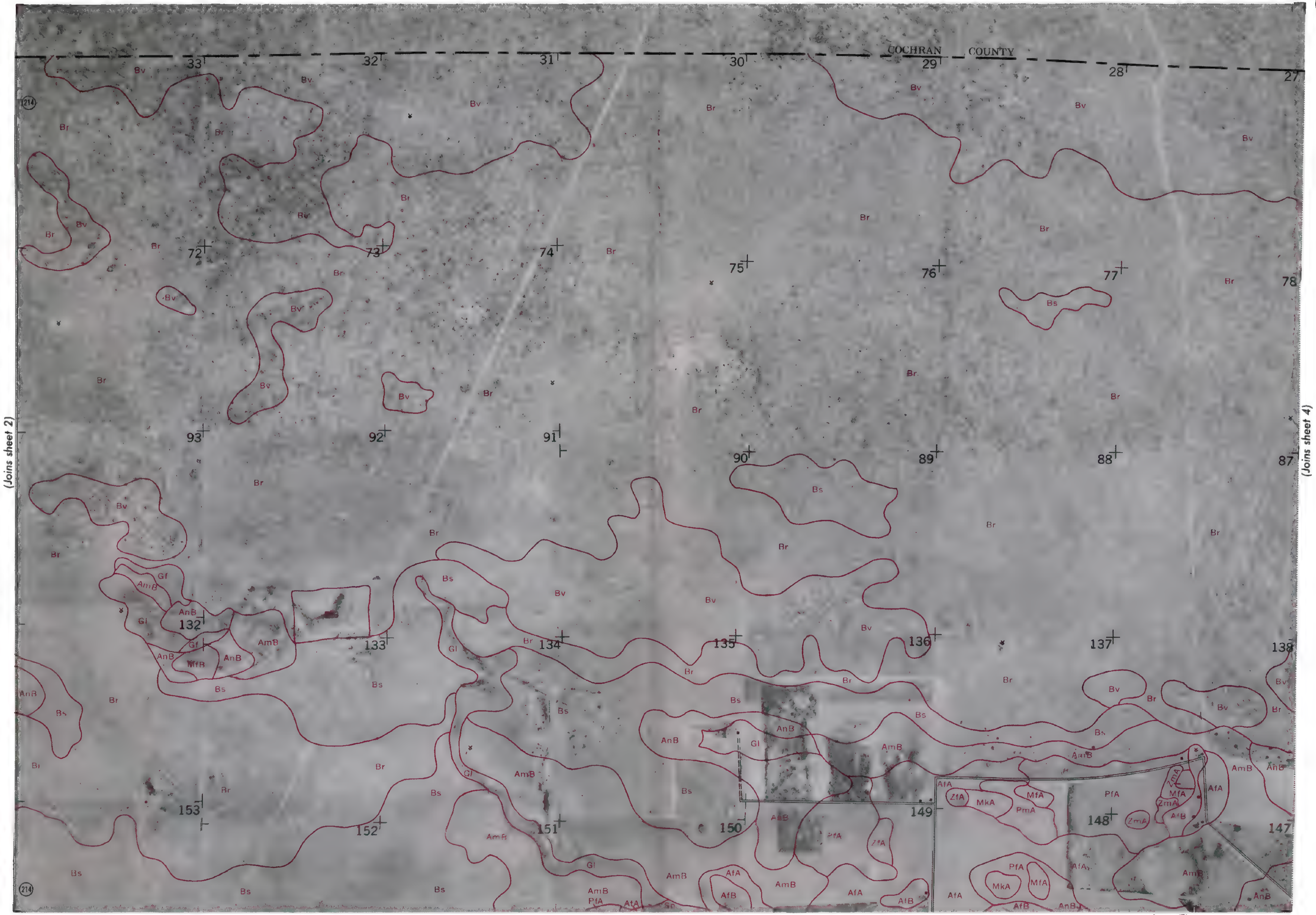
0 ½ 1 Mile

Scale 1:31680

0 5000 Feet

YOAKUM COUNTY TEXAS — SHEET NUMBER 2





0 ½ 1 Mile Scale 1:31680 0 5000 Feet

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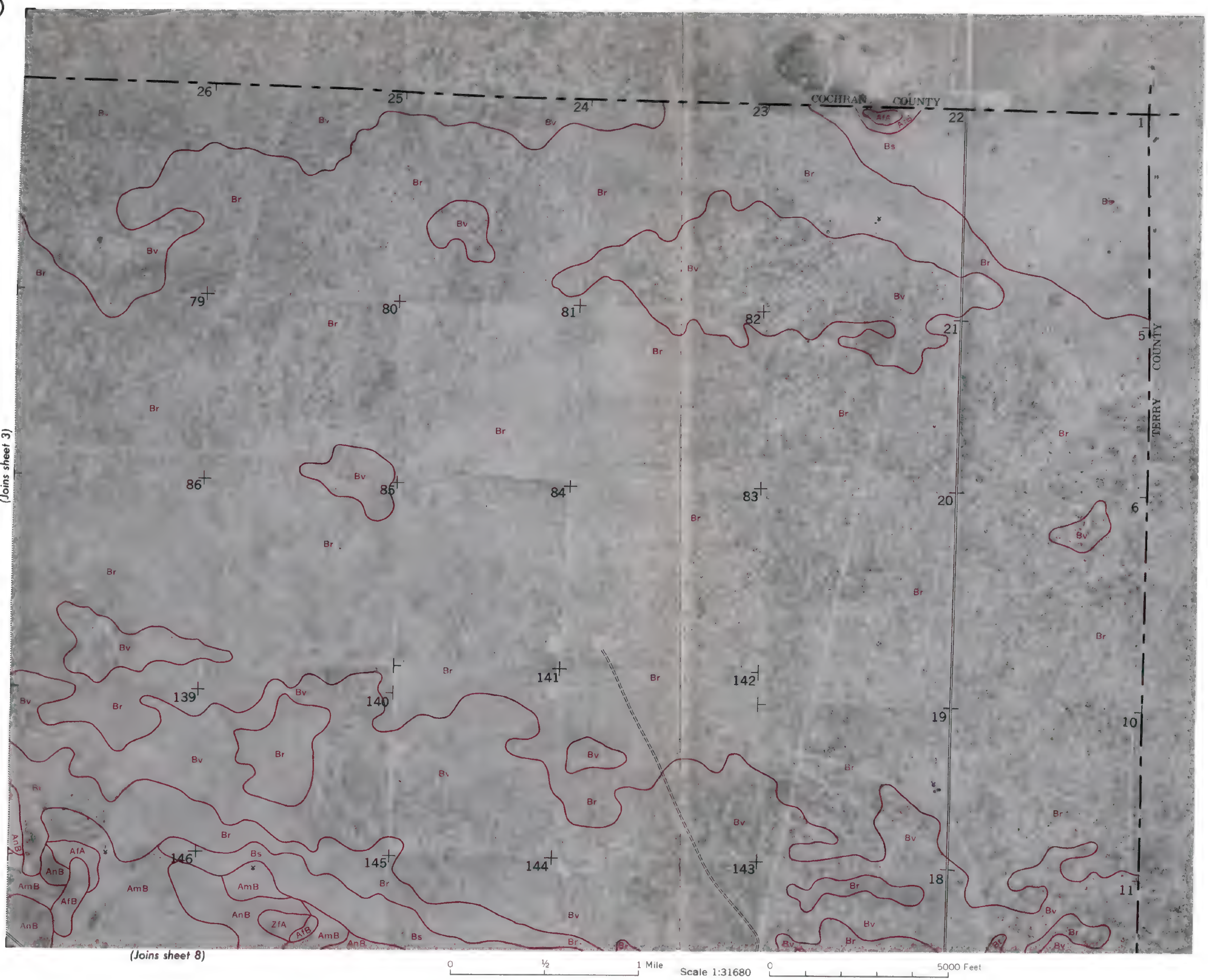
N
COCHRAN COUNTY
TERRY COUNTY
(Joins sheet 3)
(Joins sheet 8)
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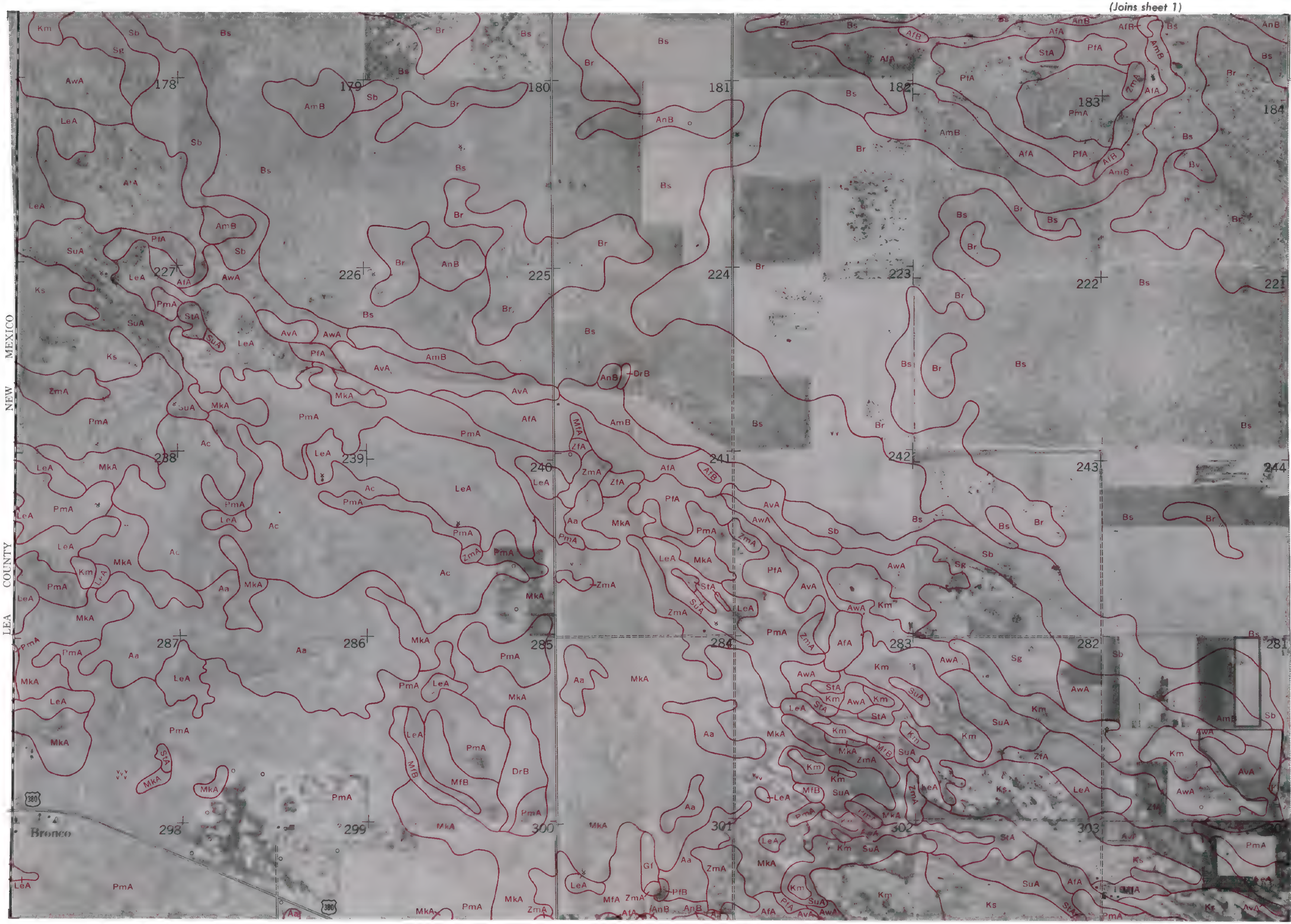
145
144
143
18
Bv
Br
Bs
AfA
AfB
AnB
AmB
ZfA
0 ½ 1 Mile
Scale 1:31680
0 5000 Feet

5



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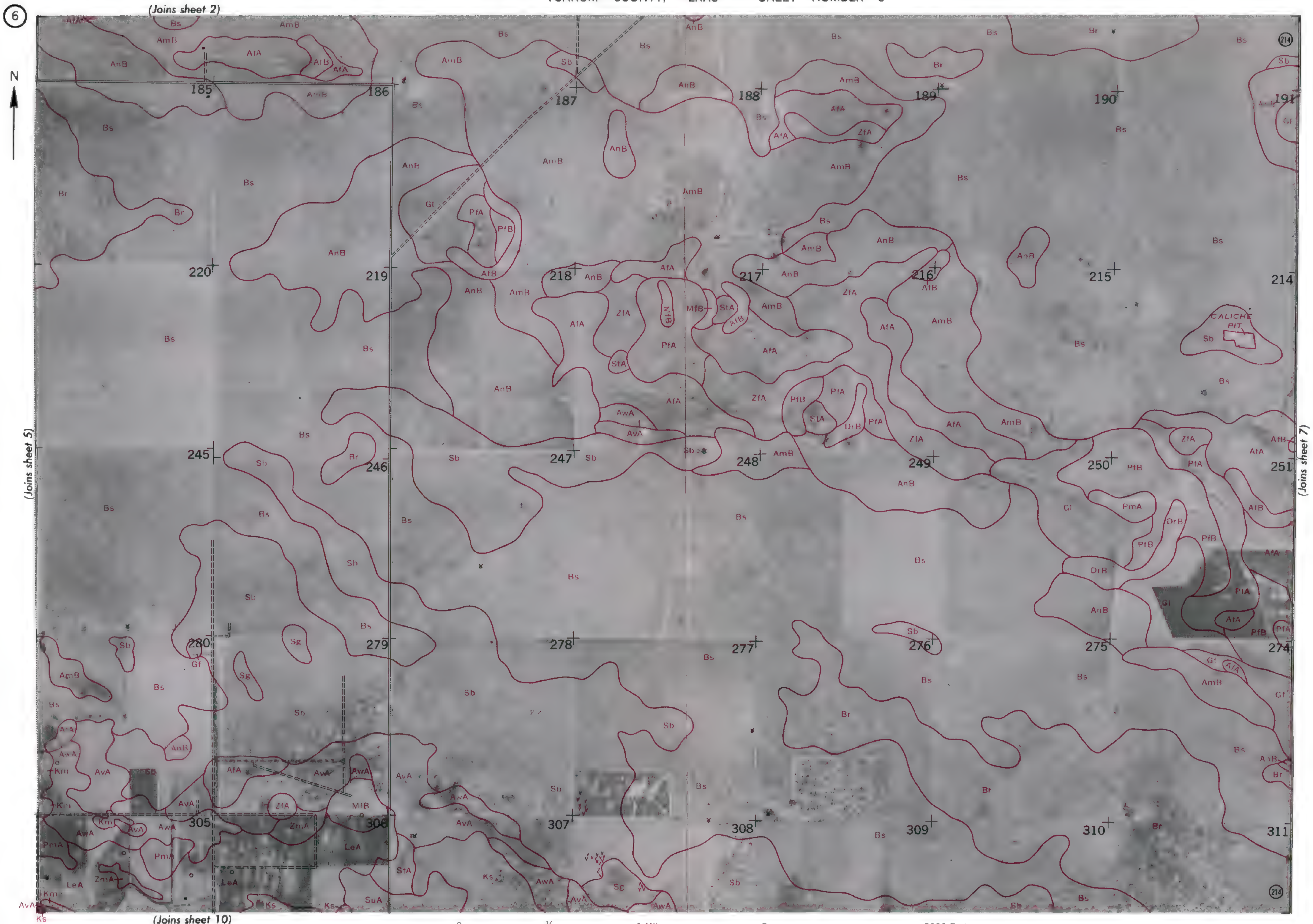
This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.



0 ½ 1 Mile Scale 1:31680 0 5000 Feet

(Joins sheet 3)

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 11)

0 ½ 1 Mile Scale 1:31680 0 5000 Feet

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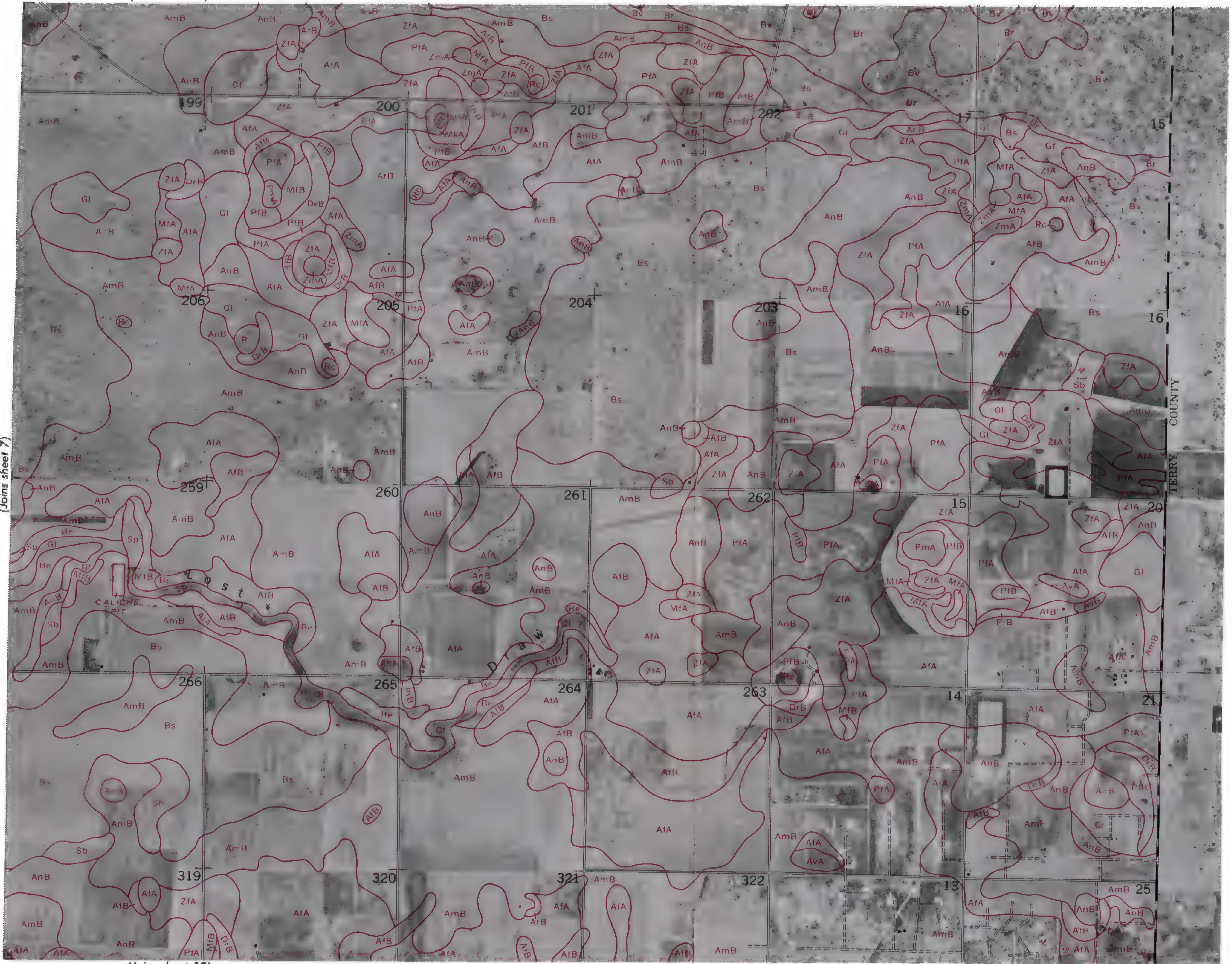
YOAKUM COUNTY, TEXAS — SHEET NUMBER 8

(Joins sheet 4)



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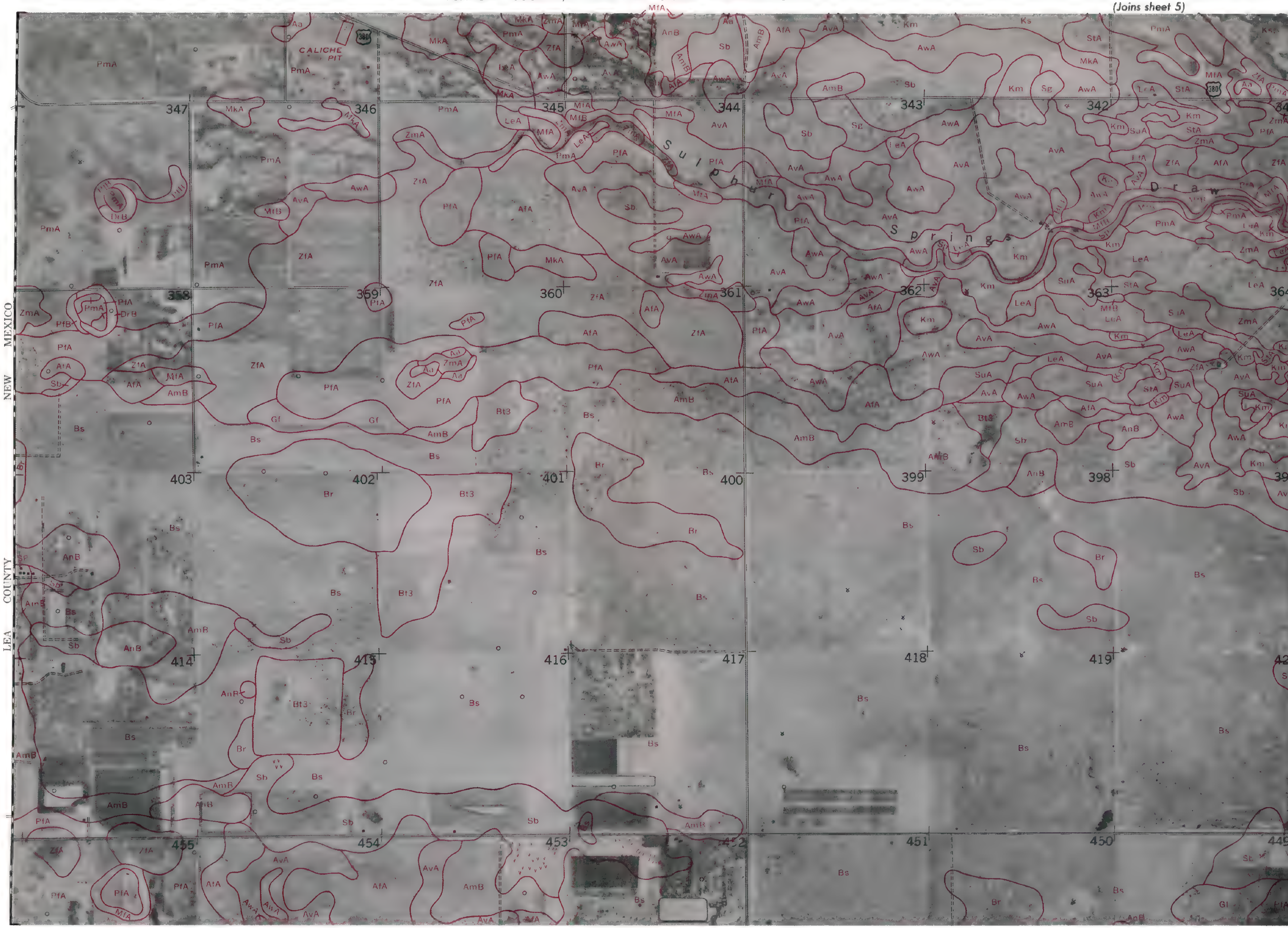
0 ½ 1 Mile Scale 1:31680 0 5000 Feet

(Joins sheet 5)



(Joins sheet 10)

(Joins sheet 13)

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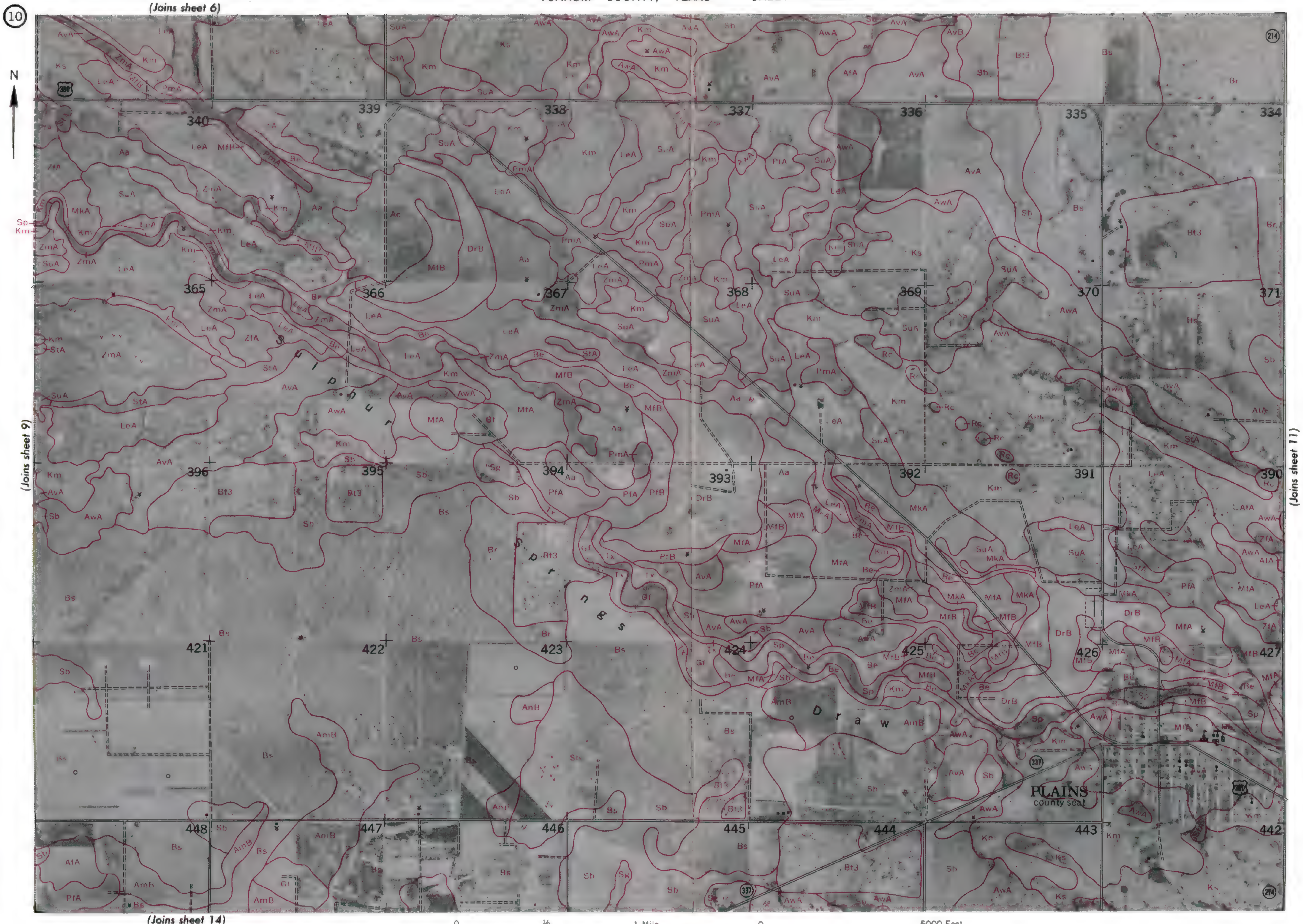

0 ½ 1 Mile Scale 1:31680 0 5000 Feet

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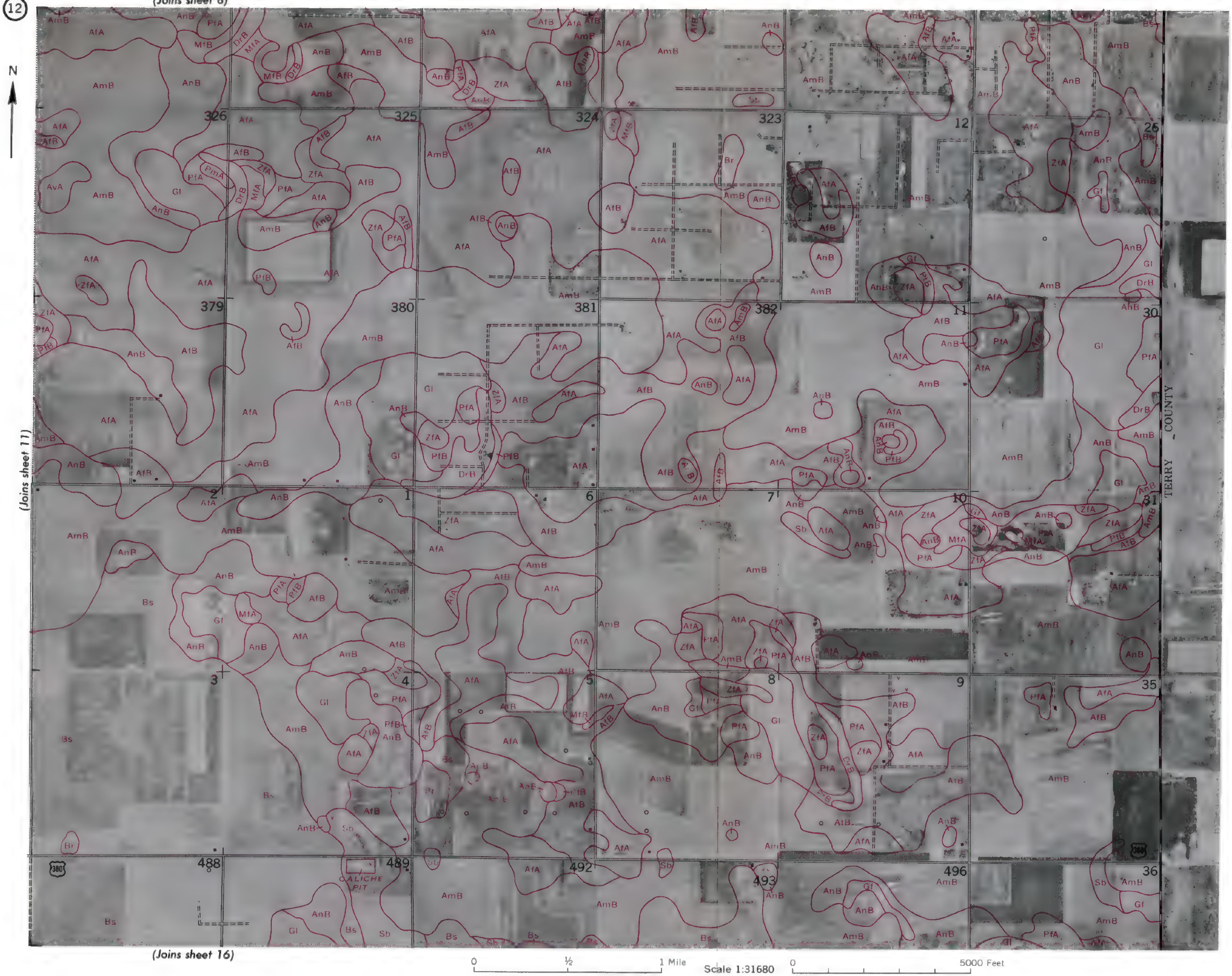
0 ½ 1 Mile Scale 1:31680 0 5000 Feet

(12)

YOAKUM COUNTY, TEXAS — SHEET NUMBER 12



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0 ½ 1 Mile Scale 1:31680 0 5000 Feet

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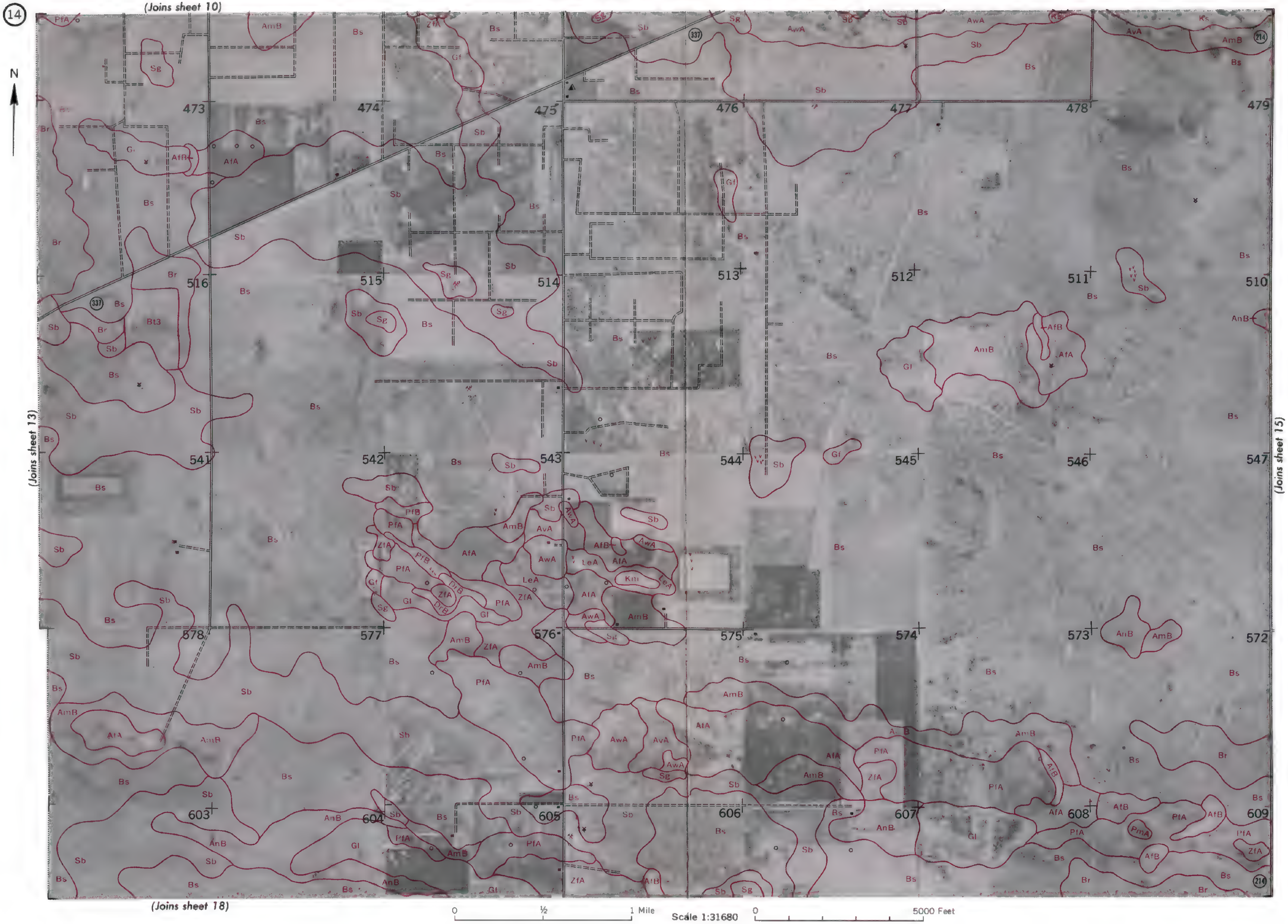
14
(Joins sheet 10)
N
(Joins sheet 13)
(Joins sheet 15)
(Joins sheet 18)
473
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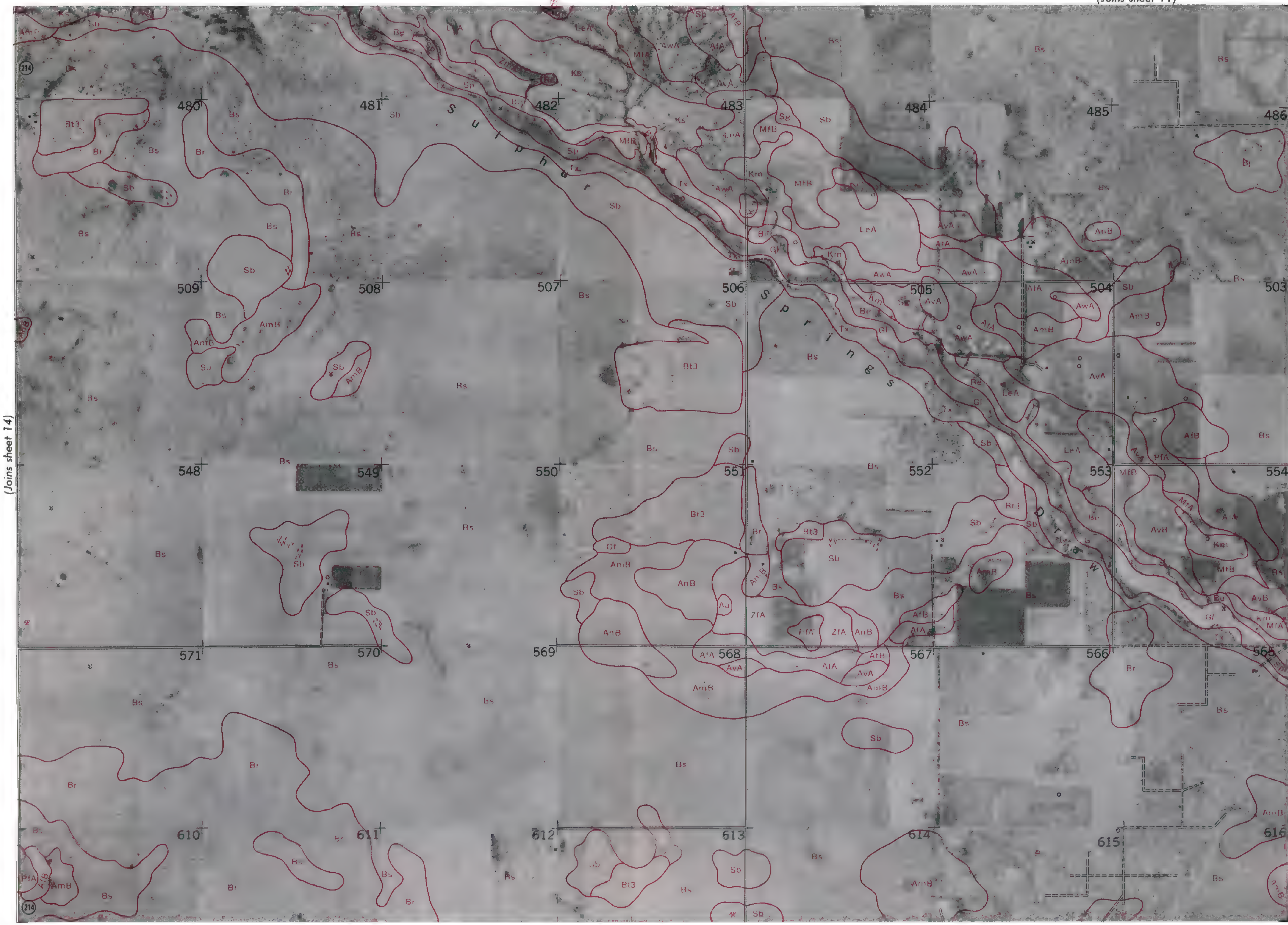
0 ½ 1 Mile
Scale 1:31680
0 5000 Feet

YOAKUM COUNTY, TEXAS — SHEET NUMBER 15

(Joins sheet 11)

15

(Joins sheet 14)



(Joins sheet 16)

(Joins sheet 19)

0 ½ 1 Mile Scale 1:31680 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

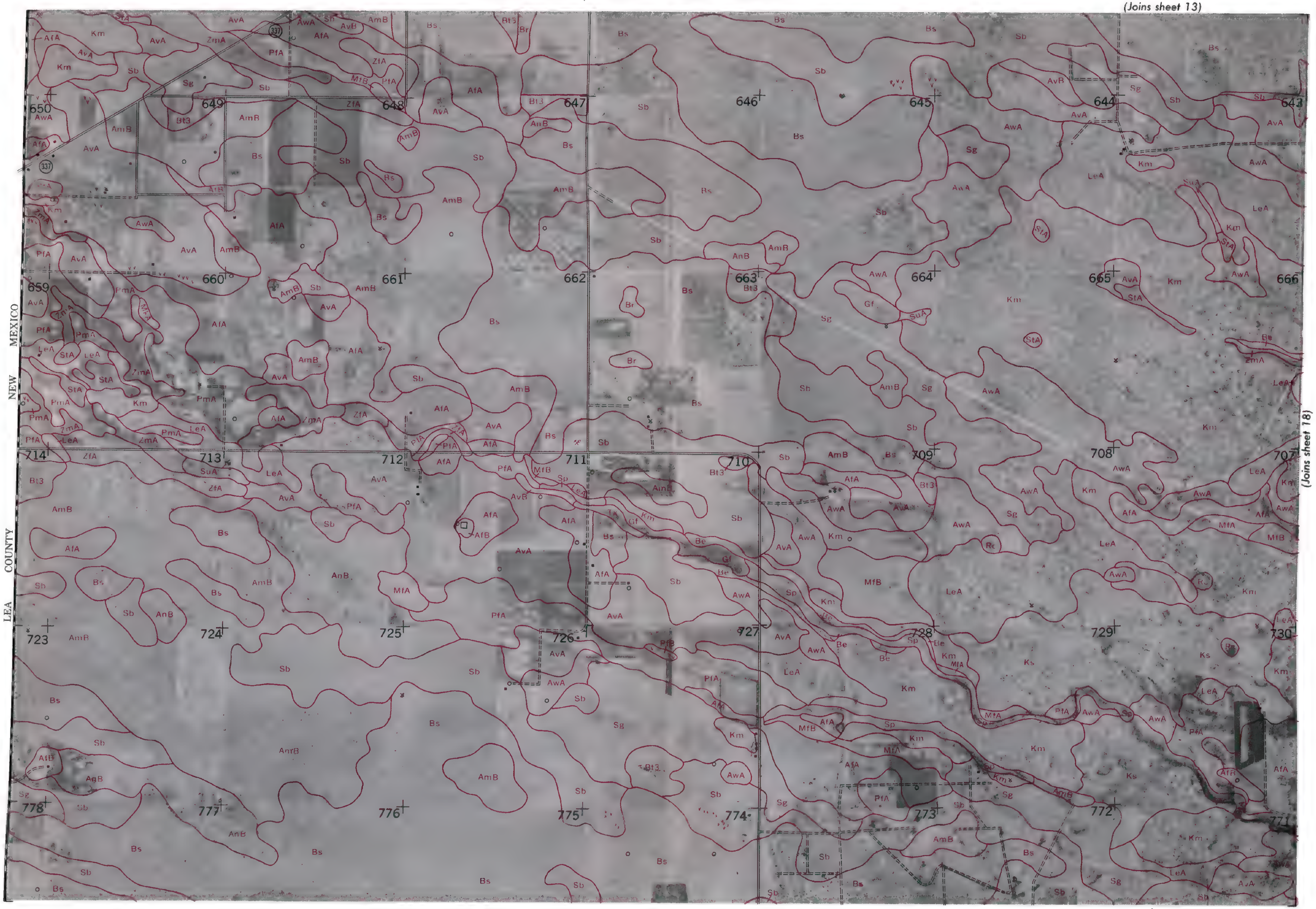
Land division corners and numbers shown on this map are indefinite.

(Joins sheet 12)

(Joins sheet 15)

(Joins sheet 20)

0 ½ 1 Mile Scale 1:31680 0 5000 Feet



Scale 1:31680

0 ½ 1 Mile

0 5000 Feet

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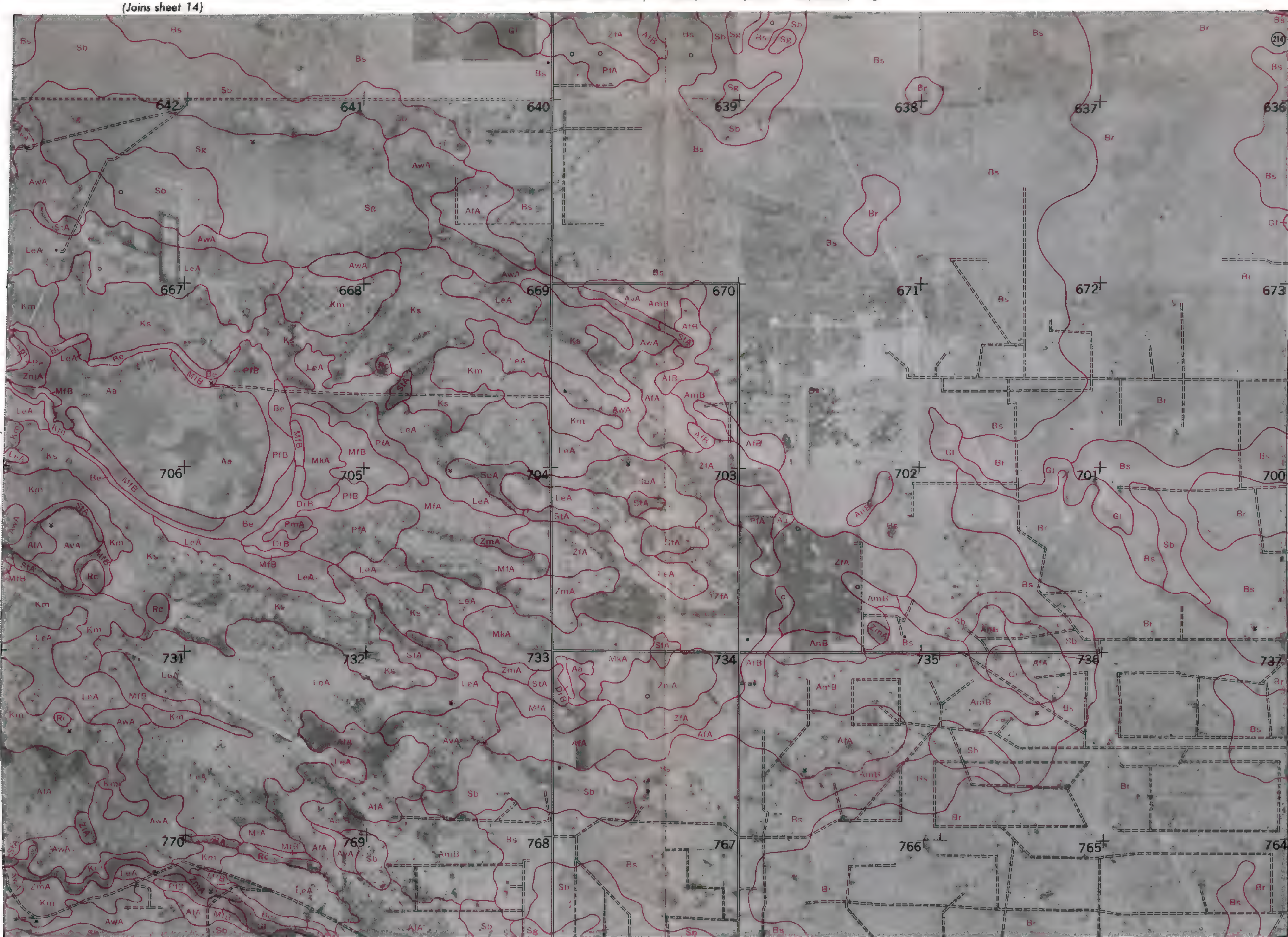
18

(Joins sheet 14)

N



(Joins sheet 17)

(Joins sheet 19)

(Joins sheet 22)

0 ½ 1 Mile

Scale 1:31680

0 5000 Feet

(Joins sheet 15)

(Joins sheet 23)

0 ½ 1 Mile Scale 1:31680 0 5000 Feet

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YOAKUM COUNTY, TEXAS — SHEET NUMBER 20

(20)

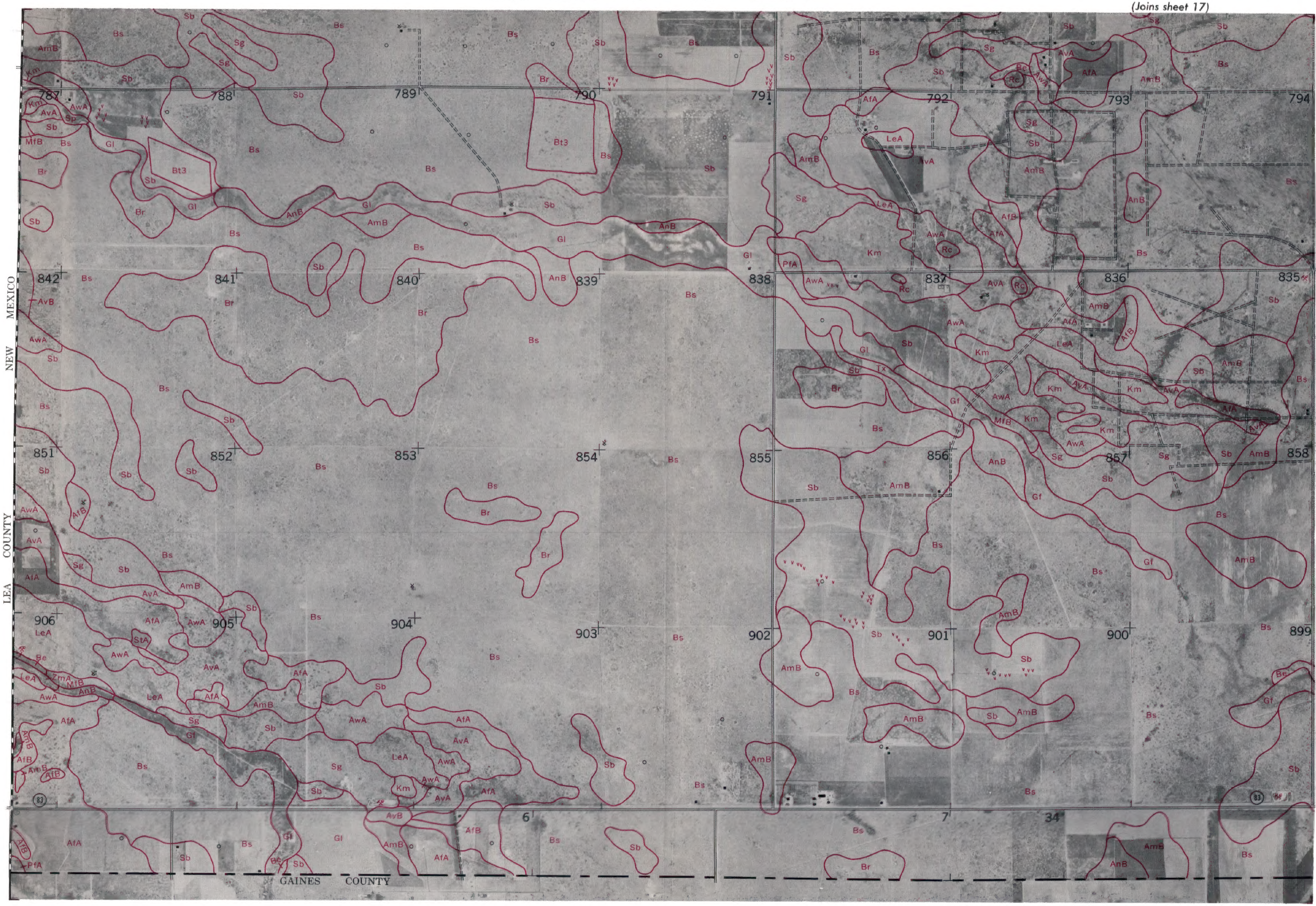
(Joins sheet 16)

(Joins sheet 19)

(Joins sheet 24)

0 ½ 1 Mile Scale 1:31680 0 5000 Feet

YOAKUM COUNTY, TEXAS — SHEET NUMBER 21



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0 ½ 1 Mile Scale 1:31680 0 5000 Feet

(22)

YOAKUM COUNTY, TEXAS — SHEET NUMBER 22

(Joins sheet 18)

0 ½ 1 Mile Scale 1:31680 0 5000 Feet

(Joins sheet 19)

23

0 ½ 1 Mile Scale 1:31680 0 5000 Feet

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0 ½ 1 Mile Scale 1:31680 0 5000 Feet